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MANAGEMENT ALTERNATIVES AND RECONNAISSANCE SURVEY

EXPANSION OF CRATERS OF THE MOON NATIONAL MONUMENT

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MANAGEMENT ALTERNATIVES

EXPANSION OF CRATERS OF THE MOON NATIONAL MONUMENT

August 1990

U.S. Department of the Interior / National Park Service

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INTRODUCTION

BACKGROUND

Legislation (H.R. 3782) has been introduced to establish a national park and preserve in southeastern Idaho, which would include and add to the present Craters of the Moon National Monument. Although there is local and statewide support for a national park as well as opposition to any change, there is little consensus on the boundaries and management concepts.

The National Park Service's *Reconnaissance Survey, Expansion of Craters of the Moon National Monument* (1989), discussed the national significance of the Great Rift system and adjoining areas of the Snake River Plain. That document is reprinted following this report and should be referred to for resource descriptions, landownership, and other information about the study area. The survey concluded that, as a whole, the Great Rift system, the deepest known open volcanic rift on earth and the longest volcanic rift in the continental United States, is nationally significant and that it deserves additional protection, but that it does not meet the criteria for designation as a national park. Furthermore, administration by the National Park Service (NPS) is not required to provide additional resource protection; some modification of Bureau of Land Management (BLM) management emphasis would provide adequate legal protection under their administration. In the area under consideration for expansion, BLM has designated several areas of critical environmental concern (ACEC); these areas receive special emphasis on the protection of natural and cultural resources. Proposed BLM wilderness designation for much of the area considered for expansion, along with designation of additional areas of critical environmental concern, would further enhance protection.

Because of resource significance and public interest, the Park Service has been requested by the Idaho congressional delegation to continue to the next step, a study of alternatives. A study of alternatives generally requires extensive fieldwork to provide an information base upon which to make alternative boundary and management recommendations. Funding was not available to conduct field investigations, and the study team relied on available information, primarily from the BLM. The alternatives in this report are therefore conceptual, recognizing that the boundaries would need "fine-tuning."

SCOPE OF REPORT

This report discusses (1) objectives and concerns of various interest groups, individuals, and agencies, (2) alternative management concepts, some of which might accomplish various objectives and resolve concerns, and (3) summarizes public comment on the alternatives..

Neither the BLM nor the Park Service has selected a preferred alternative, and inclusion of an alternative does not imply endorsement by either agency.

WHY AN EXPANDED PARK?

Idaho does not have a national **park**, although there are several national park system units in the state, including Nez Perce National Historical Park and City of Rocks National Reserve. National park designation is most prestigious and an objective of most expansion supporters. Various interest groups seek to achieve different objectives with expansion of Craters of the Moon National Monument into a national park. Some probably would be

satisfied with renaming the existing area as a national park. Others want a much larger national park. Designation of the entire Great Rift system area as a national park or national monument, however, would undoubtedly not be acceptable to the grazing/hunting interests, even if these uses were protected in the legislation. (To protect existing grazing/hunting uses in some areas, it would be appropriate to establish a preserve or other administrative category.)

To other interest groups, an increase in tourism is the primary objective, and a large block of land to appear on maps as a national park is seen as a means to this objective. Crystal Ice Cave was a draw for travelers following the interstate along the Snake River. The area was abandoned by the concessioner, and the cave is closed to the public. Facilities, marginal to begin with, have deteriorated, and the natural features have been severely compromised. There is expectation by some interest groups that the Park Service would restore this facility as a significant tourist draw.

To other interest groups, the issue is not so much the name or size, but the administrative policies applied. Generally, the Park Service has tried to keep **national parks** free from activities such as grazing and hunting. There is some public apprehension when these activities are permitted in areas under NPS administration. Cooperative administration also presents problems when the managing agencies have significantly differing philosophies. Conflicts are bound to arise. This could be a problem where existing grazing allotments are split between two agencies to manage, as is proposed in the pending legislation. The agencies' methods for determining AUMs (animal unit months) would be expected to differ, with the Park Service using more conservative numbers.

Another interest group sees national park designation as a means to achieve a highway between Arco and Minidoka. The highway would provide access to the park expansion areas while reducing travel distances between the Burley/Rupert area, the Idaho National Engineering Laboratory, and the seed potato farms near Arco. Access to hunting areas would also be improved.

AGENCY CONCERNS

Establishing and Promoting Tourism in the Southern Area

Designation of the Wapi/King's Bowl/Crystal Ice Cave area as a national park would raise expectations for increased tourism in the region, and the Park Service is concerned about these high expectations. National park designation would not necessarily increase visitation; most of the area included in the expansion would be managed as wilderness, and there are few "spectacular" features in the southern area of interest to the general public. In contrast to the diverse volcanic formations and varied topography in the existing monument, the harsh lava flows and the lack of topographic variety in the southern area would make the area uninviting as a destination for many visitors. Although significant, the Great Rift system is not the tourist attraction sought by various interests in southeastern Idaho. Publicity about the "new park" would probably initially increase visitation to the area, but this would taper off as the traveling public learns of the lack of facilities and the harshness of the area.

If NPS administration is legislated in the southern area, it will take considerable effort to develop a focal point around Crystal Ice Cave/King's Bowl for visitors. The Park Service would normally prepare a general management plan for the park before proceeding with any development. That process can take several years; however, there will be pressure for immediate improvements in this area. Virtually all existing facilities, including trails, would

need to be replaced or drastically reconstructed. It would take extensive research to determine **IF** cave visitation should be allowed and **HOW** to restore the ice cave. The trail into King's Bowl is in poor condition and might not be safe for visitor use. A reconstructed interpretive trail in the King's Bowl area and possibly a nature trail in Wapi Park could offer visitors something to explore in addition to the ice cave (if it is ever reopened). For the more adventurous, there are rugged hiking opportunities throughout the area. National park visitors would expect a campground(s). The lack of water and attractive terrain limit the possibilities. (Locations for campgrounds, if any, would be determined during future planning efforts.) The Park Service would need extensive funding to install utility systems, upgrade access roads, and develop trails, waysides, and a modest visitor center with exhibits and information about areas to explore on both NPS and BLM lands. Some of these actions could be implemented as an interim approach until a general management plan was completed for the entire area under NPS administration or a joint management plan was completed with BLM.

Administrative Concerns

Ensuring protection of the significant resources of the Great Rift system should be the primary objective of any movement to expand Craters of the Moon National Monument. The Park Service and the BLM are equally concerned about protection of the natural and cultural resources of the area. Much of the land being proposed as a national park or preserve has been proposed for wilderness, and BLM is in the process of evaluating additional adjacent areas. These areas include the Sand Butte, Raven's Eye, Little Deer, and Bear Den Butte wilderness study areas.

The Park Service and the BLM have agreed on a boundary modification for the northwest corner of the monument to include the entire drainage basin of the monument's water resources and place the monument boundary along identifiable topographic features. The change would simplify enforcement of hunting regulations and reduce trespass grazing. Four grazing allotments and one parcel of patented land would be affected by this change; there would be a small increase in land available for grazing. This or similar modifications should be incorporated into any legislation. Furthermore, any legislation should present boundaries that follow topographic or other readily identifiable features (as much as possible) to simplify management and administration.

BLM has submitted a recommendation for a Great Rift Wilderness Area. The proposed expanded park boundary, while similar, does not exactly follow the proposed BLM wilderness boundaries and includes areas now open to hunting and grazing. The proposed boundary is often in lava flows, which makes the boundary extremely difficult to mark and administer and could preclude designation of the wilderness as now proposed. If the expanded park is intended to include only the lava flows, the proposed wilderness boundary should be followed. It would be preferable to have wilderness designation completed with any expansion legislation.

Any legislation should provide some latitude in determining final boundaries. Section 2(e) of H.R. 3782 allows six months for preparation of a legal description of the park and preserve. Sections 2(b) and (c) give approximate acreage. This appears to provide the administering agencies some latitude in determining final boundaries that minimize administrative conflicts. Six months might prove to be inadequate due to the rugged landscape and the need for additional studies.

The cost for surveying the proposed BLM wilderness boundary has been estimated at $980,000. The cost would be even higher to survey the larger area in the proposed

legislation. Funds to accomplish the necessary surveys, initiate planning efforts, and establish an initial NPS presence on former BLM lands are not ensured with the passage of legislation. Any transition from BLM to NPS administration would require some time to accomplish and should not compromise either agency's existing programs.

The proposed legislation boundary includes some areas under NPS administration where hunting and/or grazing would be permitted. Under the proposed legislation, the Park Service would manage grazing allotments that are contiguous with BLM allotments. Twenty current allotments would be divided between NPS and BLM administration, requiring some ranchers to deal with both agencies. The Park Service has little expertise in grazing management, and it would be inefficient to have two agencies carrying on the same role in adjoining areas.

H.R. 3782 permits grazing (but not hunting) in the park, but section 2(f) states that any regulation applicable to the monument is "deemed" applicable to the park. There is some concern that the legislation could be interpreted to allow grazing on present monument lands or, conversely, to allow the Park Service to prohibit grazing throughout the park. It would be preferable to define boundaries so that grazing and hunting are not included under NPS management. (This is relatively easy to do for grazing if the edges of the lava fields are followed. However, hunting, even if minimal, does occur on the lava fields and is considered a unique hunting experience by regional sportsmen.) Hunting and grazing are generally not compatible uses in areas intended for intensive visitor use such as the King's Bowl area. If the King's Bowl/Wapi Park area is to become a focal point for visitation, hunting on adjacent lands could be a safety hazard. An access corridor, without hunting, should be provided.

If the legislation is intended to recognize the nationally significant Great Rift system, the Open Crack Rift Set, which some propose deleting from the legislation, should be included to present the full spectrum of significant features. Similarly, geologically unrelated features, such as Big Southern Butte, logically should not be included in the park.

The dual names included in the legislation would probably confuse visitors and complicate interpretation. Simplifying the name of the proposed park unit would reduce visitor confusion and simplify promotion. Calling the area Great Rift National Park and Preserve would recognize the true significance of the resources; the existing monument developed area could be the Craters of the Moon unit. Of course, the mystique of the existing name would be lost.

The BLM reports some instances of hazardous waste dumping in areas being considered for NPS administration. The extent of the problem is not fully known, but it is known that individuals have disposed of various materials, including agricultural chemicals, on BLM lands. The Park Service would not be able to accept lands containing hazardous wastes until they are clean. However, if these lands are transferred to the Park Service prior to cleanup, NPS costs could be high.

Other issues to be studied include air quality (the monument is a class I air quality area), mineral rights, and other valid claims in the areas being considered for inclusion in an expanded monument.

ALTERNATIVES

The following alternatives present different management concepts and briefly discuss the manner in which each concept addresses the objectives and concerns of individuals, groups, and agencies. Administrative responsibility is indicated in parentheses.

The alternatives being considered are as follows:

Administrative Alternatives

Alternative A – No action

Alternative B – H.R. 3782 - Craters of the Moon National Park & Great Rift National Preserve (four units, all administered by NPS)

Alternative C – Rename the monument Craters of the Moon National Park (NPS)

Alternative D – Create the Great Rift National Science Reserve (BLM as lead agency)

Cooperative NPS/BLM Management Alternatives

Alternative E – Great Rift National Park (NPS) and Preserve (BLM)

Alternative F – Craters of the Moon National Monument (NPS) and Great Rift National Conservation Area (BLM)

It should be noted that only one alternative (the pending legislation) would include the Big Southern/Cedar Butte areas and none would ensure construction of a highway.

SUMMARY OF ALTERNATIVES - CRATERS OF THE MOON EXPANSION

The alternatives presented are intended to stimulate further discussion. Alternatives may be combined, eliminated, or new ones developed as discussions continue. Neither the BLM nor the Park Service has selected a preferred alternative, and inclusion of an alternative does not imply endorsement by either agency.

ALTERNATIVE A

No Action

No change in administration, no change in existing uses

ALTERNATIVE B

CRATERS OF THE MOON NATIONAL PARK & GREAT RIFT NATIONAL PRESERVE

Includes Big Southern/Cedar Buttes
All NPS administration
(Stallings' bill)

Establishes national park in Idaho, recognizes most of the Great Rift system and unrelated areas as nationally significant, difficult to administer, potential conflicts with existing uses in areas under NPS management, strong NPS identity, possible increase in tourism

ALTERNATIVE C

Rename the monument
CRATERS OF THE MOON NATIONAL PARK

Establishes a national park in Idaho, no change in administration, no change in existing uses, possible minor increase in tourism, no recognition of the significance of the Great Rift system

---------- **COOPERATIVE NPS/BLM MANAGEMENT ALTERNATIVES** ----------

ALTERNATIVE D

GREAT RIFT NATIONAL SCIENCE RESERVE

BLM lead agency with NPS, state, and other agencies cooperating

Recognizes all of Great Rift system as nationally significant scientific area, emphasis on research, resource management and education, no change in administration, possible future effect on existing uses, no effect on tourism

ALTERNATIVE E

GREAT RIFT NATIONAL PARK AND PRESERVE

NPS/BLM cooperative management

Establishes national park in Idaho, recognizes most of the Great Rift system as nationally significant, minimal conflict with existing uses, possible increase in tourism

Option: NPS administration of Wapi Lava Field/King's Bowl area as part of park; no hunting or grazing in park causes some conflict with existing uses

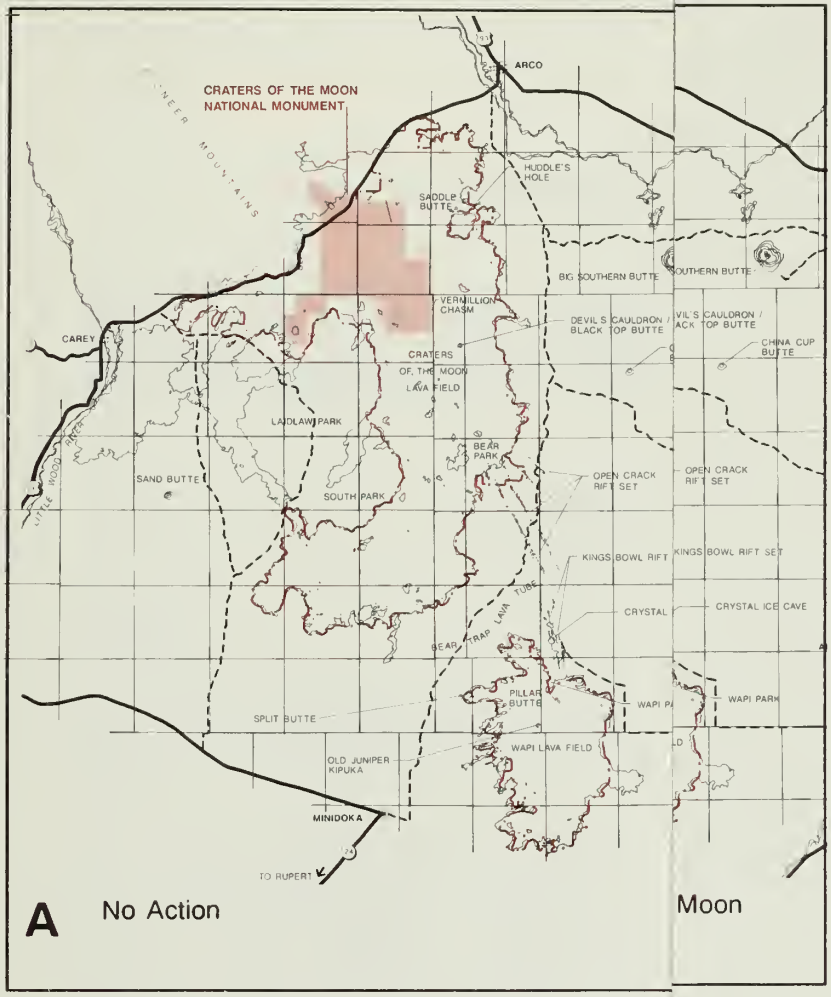
ALTERNATIVE F

CRATERS OF THE MOON NATIONAL MONUMENT & GREAT RIFT NATIONAL CONSERVATION AREA

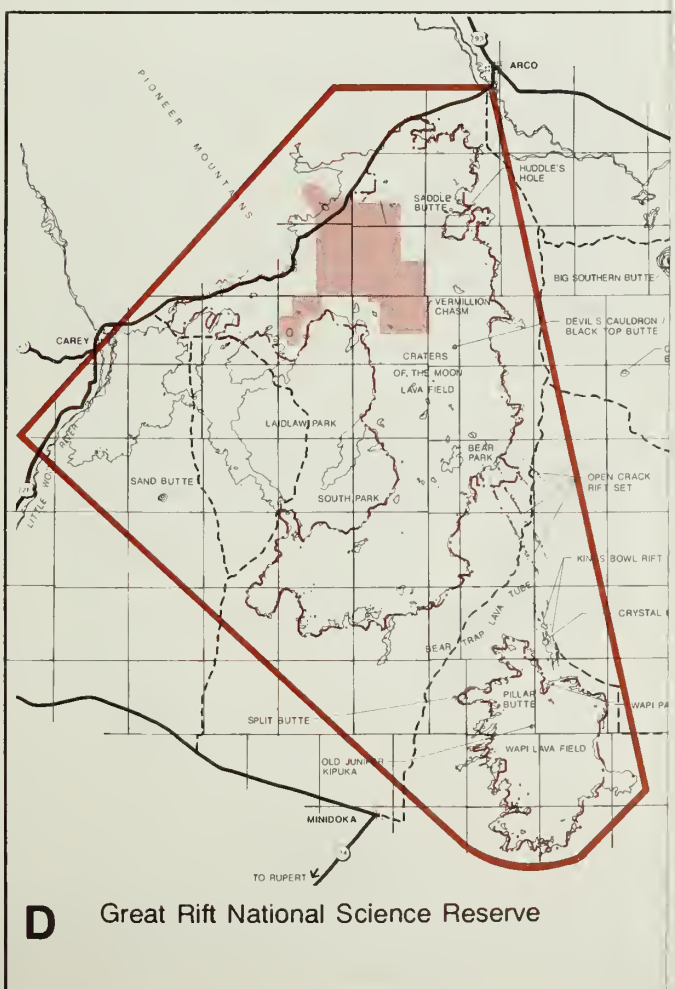
NPS/BLM cooperative management

Recognizes most of the Great Rift system and adjoining lands as nationally significant, possible future effect on some existing uses due to recreational use in Laidlaw Park area, minimal effect on tourism but highest for regional recreation potential

These two alternatives emphasize readily identifiable boundaries for ease of administration, continued BLM management of existing uses in areas under their administration, and no grazing or hunting on NPS administered areas. Private lands, if included, would be acquired on a willing-seller basis.



A No Action



D Great Rift National Science Reserve

NATIONAL PARK SERVICE

BUREAU OF LAND MANAGEMENT

PROPOSED WILDERNESS BOUNDARY

ALTERNATIVES

FOR EXPANSION OF CRATERS OF THE MOON NATIONAL MONUMENT

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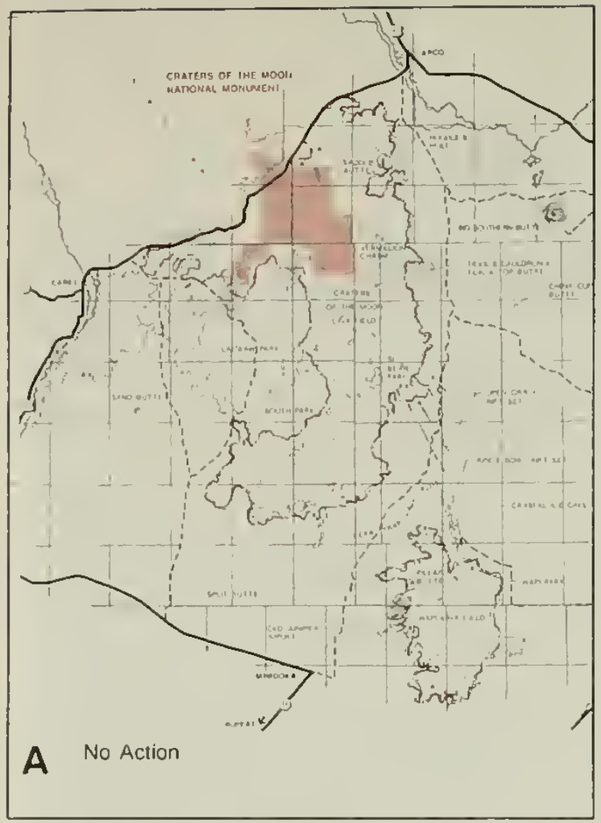

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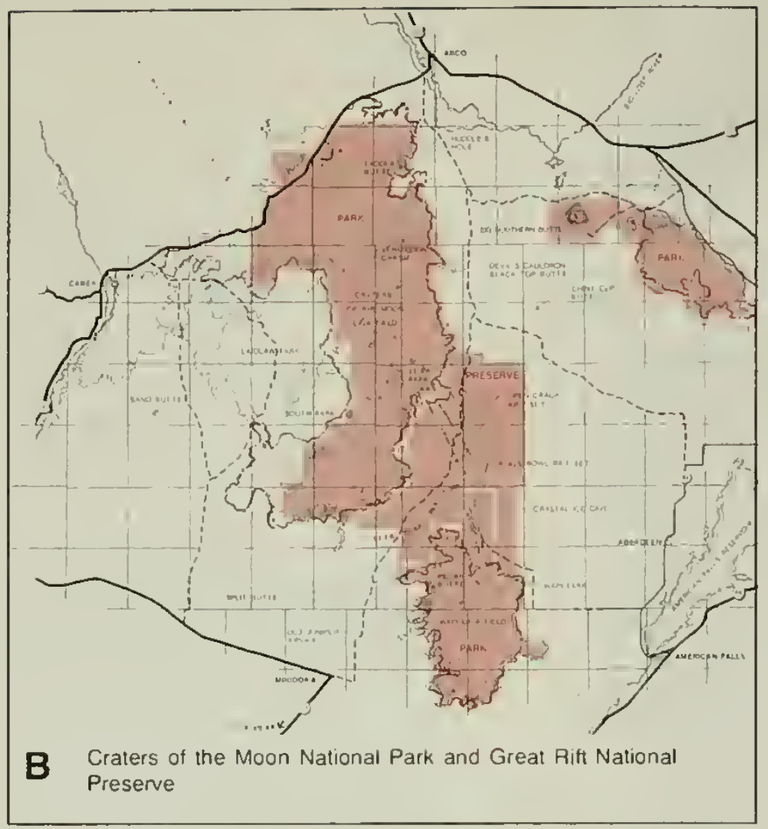
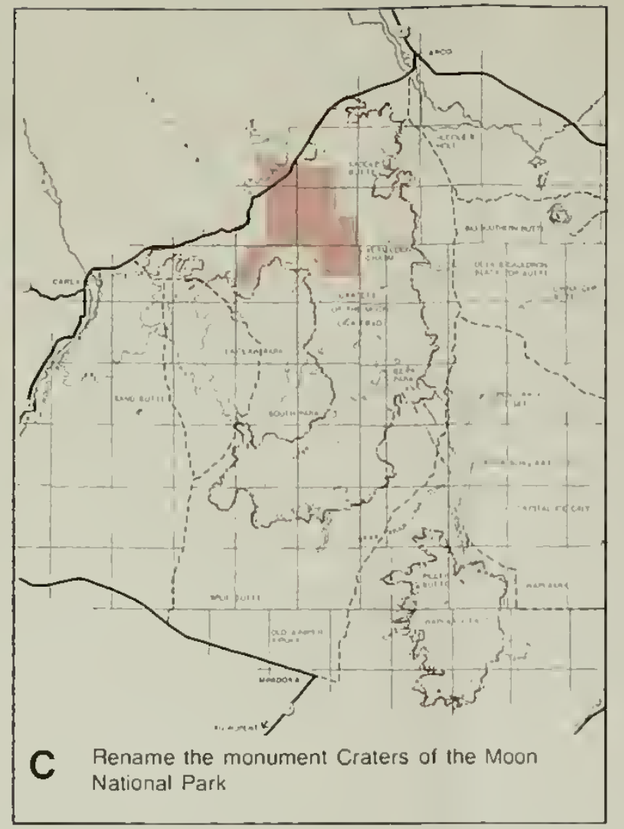
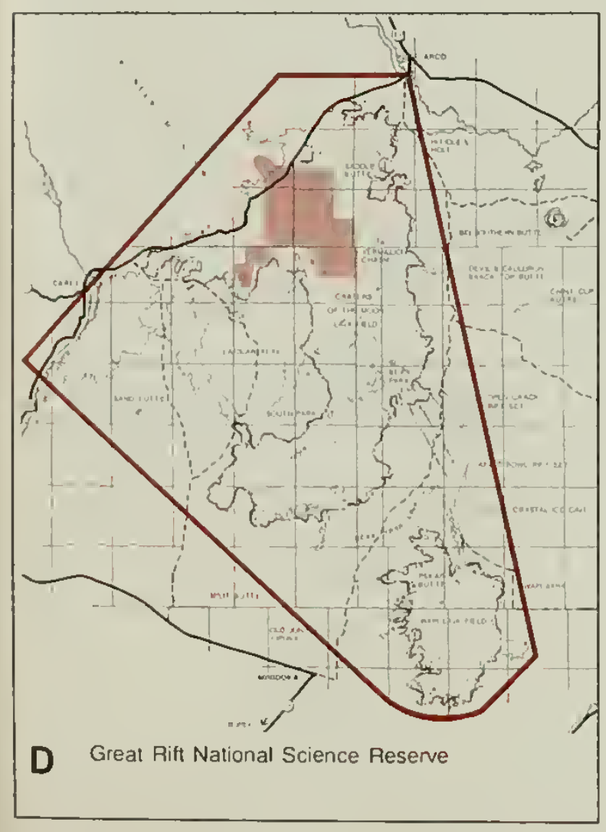


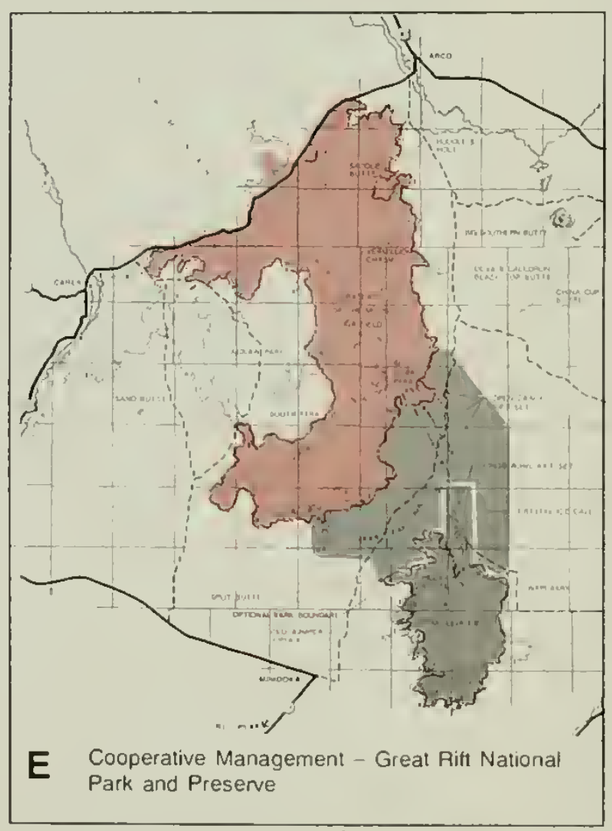
B Craters of the Moon National Park and Great Rift National Preserve



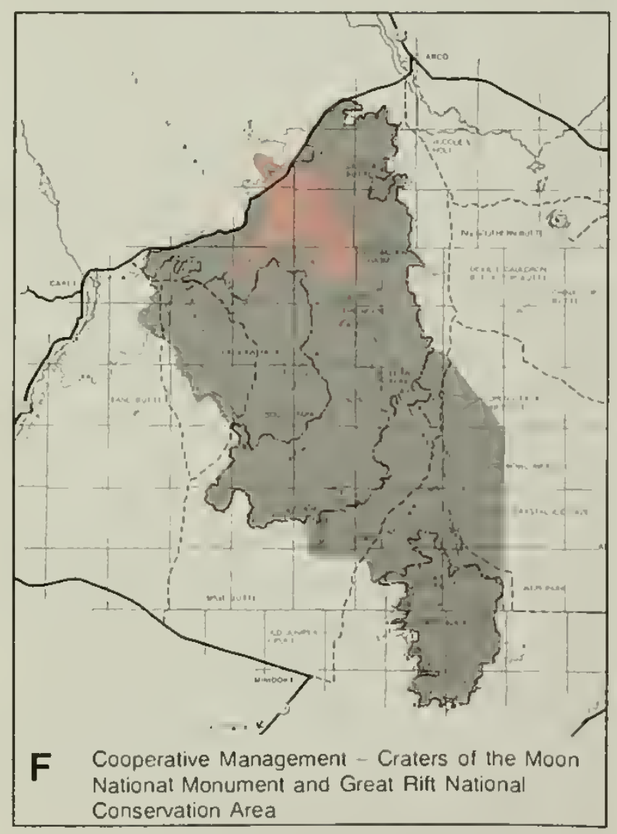
C Rename the monument Craters of the Moon National Park



D Great Rift National Science Reserve



E Cooperative Management – Great Rift National Park and Preserve



F Cooperative Management – Craters of the Moon National Monument and Great Rift National Conservation Area

NATIONAL PARK SERVICE

BUREAU OF LAND MANAGEMENT

PROPOSED WILDERNESS BOUNDARY

ALTERNATIVES

FOR EXPANSION OF CRATERS OF THE MOON NATIONAL MONUMENT

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

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ADMINISTRATIVE ALTERNATIVES

Four administrative alternatives (A-D) would emphasize continued cooperation by the Park Service and BLM under an existing memorandum of understanding. Alternative B would shift large areas from BLM to NPS administration. Alternatives C and D would be changes in administrative designation with little effect on management activities.

ALTERNATIVE A – NO ACTION

Concept

The existing national monument would continue to be administered by the Park Service with adjacent lands administered by BLM.

Some modest changes are proposed for the northwest corner of the monument to protect water resources, place the boundary along identifiable topographic features, and ease management problems for both the Park Service and BLM.

Much of the BLM lands adjacent to the monument would continue to be managed as wilderness, and select areas would be managed as areas of critical environmental concern. Under the BLM planning process other areas of critical environmental concern could be identified. Most of the remaining area being considered for expansion would continue to be managed under BLM multiple use policies.

Under existing cooperative agreements, the Park Service and the BLM would continue to assist each other in resource management, interpretation, and other activities.

Discussion

This alternative would not satisfy the interests seeking a national park in Idaho or those seeking increased tourism through a strong NPS presence outside the existing monument.

The significant resources of the Great Rift system would continue to be protected under existing BLM administrative policies.

Wilderness status for BLM lands would be determined by Congress through the normal legislative process, and select resources could receive additional protection under the BLM planning process.

Existing conditions would continue for the ranching and hunting interests.

Generally, funding restraints limit both agencies' efforts to cooperate in interpretation and other activities.

There would be no additional costs associated with this alternative.

ALTERNATIVE B – CRATERS OF THE MOON NATIONAL PARK AND GREAT RIFT NATIONAL PRESERVE

Four units under NPS administration
As defined in H.R. 3782 introduced in the Congress November 20, 1989

Concept

A large area of the Great Rift system plus additional lands east of the Great Rift system including Big Southern Butte and Cedar Butte would make up the three-unit **Craters of the Moon National Park**. The area containing the Open Crack and a portion of the King's Bowl rift sets (connecting two units of the park) would be designated the **Great Rift National Preserve**. Both the park and preserve would be under the administration of the Park Service.

Hunting and grazing would be permitted in the preserve, and grazing would be permitted in the national park.

BLM and the Park Service would coordinate the opening and closing of grazing seasons and could cooperate to provide a unified interpretive program.

Approximately nine active mining claims, 10 sections of state land, two parcels of patented land, and several public water reserves are included within the proposed boundaries. In addition there are material pits, communication sites, USGS wells, and transmission lines.

Discussion

This alternative would satisfy many of those promoting a national park in Idaho. The benefit to tourism would be difficult to predict. A strong NPS presence in the southern unit would enhance the potential to attract tourists. Experience has shown that there could be an initial increase in visitation with national park designation. However, the area under consideration lacks diversity, and many of the additional volcanic features would be of little interest to the general public; the existing monument has the more "spectacular" features and would continue to be the focal point for visitors. A major effort would be needed to provide a quality visitor experience in the added areas.

The proposed park boundary does not follow topographic and lava margin features, which would make the boundary extremely difficult to mark and administer. For the most part, the boundary of the north unit seems to be within the lava fields, but there are some small patches outside the lava fields where grazing would be permitted; the south park unit would contain both small pockets and fairly large areas of permitted grazing.

Hunting within the lava fields would no longer be permitted in the park areas. The lack of readily identifiable boundaries would make the enforcement of hunting regulations extremely difficult. This situation would create unnecessary confusion and complexity. With some boundary modifications, these problems could be reduced. Keeping the preserve under BLM administration would avoid many problems.

Discussion (cont.)

Because the proposed park boundaries do not follow the wilderness proposal, a new wilderness proposal would be required. Wilderness status for these lands would not be resolved for some time.

The Park Service would manage grazing allotments contiguous with BLM grazing allotments. Although grazing rights would be protected under the proposed legislation, conflicts would be likely due to differing management policies. Grazing would be allowed in and hunting would be permitted on preserve lands adjacent to the King's Bowl area. If the King's Bowl area became a focal point for visitation, the grazing and hunting activities would not be compatible with the desired visitor experience. Hunters and ranchers would also have to deal with an additional agency.

The proposed Big Southern Butte unit is not related to the same geologic forces that created the Great Rift system represented in Craters of the Moon. It would make little sense to call Big Southern Butte "Craters of the Moon National Park." Other existing uses on or near Big Southern Butte might conflict with NPS administrative policies.

Costs for NPS administration would increase significantly. Development costs to provide facilities for management, staff, and visitors would be substantial. Management complexities due to grazing and hunting and unnatural boundaries would offset presumed advantages of total NPS administration.

ALTERNATIVE C – RENAME THE MONUMENT CRATERS OF THE MOON NATIONAL PARK

Concept

The existing national monument would be renamed **Craters of the Moon National Park**. Except for the name change, this alternative would be the same as alternative A and would include the minor boundary changes in the northwest corner of the monument.

Discussion

This alternative would satisfy some special interests – there would be a national park in Idaho. The park would not be large, and tourism patterns would not significantly change.

The significant resources of the Great Rift system would continue to be protected under existing administrative policies.

Wilderness status for BLM lands would be determined by Congress through the normal legislative process, and select resources could receive additional protection under the BLM planning process.

Existing conditions would continue for the ranching and hunting interest groups. NPS lands would not receive any different level of protection due to the name change.

Generally, funding restraints limit both agencies' efforts to cooperate in interpretation and other activities.

The costs would be modest, primarily to change signs, brochures, and stationery. Publications would have to be revised as they are reprinted.

It should be noted that the monument does not meet the criteria for national park status.

ALTERNATIVE D – GREAT RIFT NATIONAL SCIENCE RESERVE

Concept

Under this alternative the Great Rift system, including the Craters of the Moon and Wapi lava fields and adjacent lands, would be designated as a national science reserve. The lands would continue under their current administration.

The science reserve would be a cooperative effort by the state of Idaho, the Bureau of Land Management, the National Science Foundation, the U.S. Geological Survey, and the National Park Service for scientific research, preservation, and public education. BLM and the Park Service would be responsible for continued protection of the resources under their administrations. The Idaho university system would coordinate scientific studies, and the Park Service would be responsible for public education and interpretation. Collection of baseline data for the comparison of relatively undisturbed and heavily disturbed lands and the changes occurring naturally or due to management practices would be encouraged. Air and water quality monitoring, continued study of the geologic process, and inventory of unique species are examples of research programs that would be carried out on a cooperative basis.

The area within the reserve would include lava fields and other features of basaltic volcanism associated with the Great Rift system and portions of adjacent sagebrush grassland ecosystems (including foothills of the Pioneer Mountains). Approximately 26 grazing allotments would be included (all or partially) within the reserve.

An objective of the reserve would be continuing funding for the varied research programs that often are cut in agency budgets.

Discussion

This alternative would not satisfy the objectives of the various interest groups promoting a national park in Idaho. The Great Rift system would be recognized as nationally significant for its scientific and educational value. The emphasis on scientific studies would do little to increase tourism in the area.

The reserve would encompass greater diversity in landforms and vegetation types common to the eastern Snake River Plain than would any of the other alternatives. It is the only alternative to include the entire Great Rift system. Coordinated, cooperative research should reduce duplication and increase the value of the projects for the participating agencies.

There would be no initial impact on grazing and hunting, but scientific studies could lead to changes in existing management policies for all or parts of the area.

Wilderness status for BLM lands would be determined by Congress through the normal legislative process.

The costs could be significant for the cooperating agencies if an active research and education program becomes a reality. Staff would be needed to coordinate the program; research camp facilities, which could also serve as public education centers, could have a high initial cost.

The concept, although not new, would need discussion and refinement. Similarly, the boundary indicated (based on a USGS study area) would need further analysis to ensure that significant features have been included.

COOPERATIVE NPS/BLM MANAGEMENT ALTERNATIVES

The following two cooperative management alternatives (E and F) would emphasize minimal conflicts with existing uses, readily identifiable boundaries, and legislated cooperative management that would allow both agencies to expend funds for resource management, development, interpretation, etc., on lands under the other agency's administration. Cooperative administration would continue BLM management of grazing and, where permitted, hunting, with the Park Service taking the lead in providing unified interpretive services. This approach would not necessarily require NPS staff in the BLM areas, although that would certainly be one approach. The Park Service could provide interpretive planning services, coordinate publications, and participate in joint training sessions with BLM providing the on-site personnel. In addition, cooperation in resource management, research, law enforcement, planning, and other activities would be possible.

Under this concept, numerous boundary configurations would be possible for the various units, and they could be designed to minimize the grazing, hunting, and administrative conflicts discussed under alternative B. The wilderness proposals could be debated and enacted as part of the legislation.

Legislation should include:

a statement prohibiting hunting and grazing on NPS-administered lands

a statement providing for continuation of existing valid uses on BLM lands (with appropriate wording to permit future change)

provisions for cooperative planning and management, including the expenditure of funds by both agencies for development and services on the other agency's lands and in nearby communities within and adjacent to the newly designated units

provisions for "fine-tuning" the boundary following passage of legislation

a provision should be made to authorize acquisition of any nonfederal lands or interests

A clear statement in the legislation that hunting and grazing would not be permitted on NPS-administered lands would let ranchers and hunters know where they stand rather than continually speculating on the Park Service's "true" intentions. (Existing valid rights would continue on any private lands within BLM or NPS areas.) The administration of grazing allotments would be left to the BLM experts, and the boundaries would be drawn to minimize the impact on these traditional uses.

A clear intent to permit expenditures of funds on lands not administered by the agency (e.g., expenditure of NPS funds on BLM lands) would avoid future questions on the legality of such expenditures. This intent should cover interpretive facilities, visitor services, and resource protection (including staff and support facilities) in the units managed by the other agency and in adjacent communities. The legislation should require a joint general management plan for the new units, allowing three years from funding to complete the plan.

ALTERNATIVE E – COOPERATIVE MANAGEMENT – GREAT RIFT NATIONAL PARK (NPS) AND PRESERVE (BLM)

Concept

This concept would provide a large area of national significance under a single name - a **national park and preserve.**

The north park unit would encompass the existing monument and the northern part of the proposed BLM Great Rift Wilderness, with minor adjustments to protect water resources and place the present monument northwest boundary along identifiable topographic features. The Park Service would generally manage to the edge of the lava fields on the north, with most of the additions managed as wilderness. Huddles Hole and some small nonlava areas would be included within the park boundary. Approximately 24 AUMs would be lost under this alternative.

The south preserve unit would include the area of the proposed BLM Wapi Lava Field Wilderness area plus a connection to the north unit to include Wapi Park, the Open Crack Rift Set, Bear Trap Lava Tube, Split Butte, and the King's Bowl Rift Set. (This area is now in three BLM districts, depending on the final boundary, and might better be placed under the administration of one district.) The preserve would be managed under existing BLM policies, hopefully with additional funding for resource management and visitor services.

An option to place the Wapi Lava Field and a small portion of the King's Bowl area under NPS administration should also be given consideration. This would be similar to the pending legislation. Two grazing allotments would be affected with a possible loss of ±600 AUMs.

Discussion

This concept would provide a large national park and adjacent preserve under a single name, maximizing the tourism potential in the name. It has the advantages of clear agency responsibilities.

The major features of the Great Rift system would be recognized as nationally significant. Although administered by two agencies, the public would likely perceive the area as a single entity.

The Park Service would not be managing hunting and grazing, thus minimizing conflict with area hunters and ranchers. The experience of hunting on the lava fields would be lost under NPS administration.

This alternative would not significantly increase NPS administrative costs other than relatively minor costs as mentioned under alternative C plus some costs to patrol the additional boundary, particularly during hunting seasons. NPS costs could increase significantly if the Park Service becomes an active participant in visitor services and interpretation in the preserve, as is intended under this concept. The added significance of the preserve could require additional funding and staff for BLM for visitor services, interpretation, and resource management.

The option to include the Wapi Lava Field and a small portion of the King's Bowl area under NPS administration would establish a strong NPS presence in this area. There would be some conflict with existing uses because grazing and hunting would not be permitted in NPS-administered areas. The conflicts could be kept to a minimum by carefully defining the boundary. Costs for major improvements to facilities at Crystal Ice Cave/King's Bowl would be significant.

ALTERNATIVE F – COOPERATIVE MANAGEMENT – CRATERS OF THE MOON NATIONAL MONUMENT (NPS) AND GREAT RIFT NATIONAL CONSERVATION AREA (BLM)

Concept

Under this alternative the Park Service would continue to administer the existing national monument and BLM would manage the national conservation area lands under existing policies (or modified policies to reflect the higher status). This concept would recognize a large area of national significance, including resources not geologically related to the Great Rift system. Numerous boundary configurations would be possible. The one shown would encompass most of the lava fields associated with the Great Rift system.

The areas adjacent to the existing monument identified for BLM wilderness designation, plus other significant resource areas and connecting links to include the major features of the Great Rift system, would be designated a national conservation area (or a similar special designation) to recognize the significant natural and cultural resources of the area.

The conservation area would include features such as Laidlaw Park and Huddles Hole - managed for multiple use but recognized as contributing features in the conservation area concept. Laidlaw Park could offer camping and hiking opportunities not specifically available under other alternatives. Most of Huddles Hole, included as a possible campground site and wilderness threshold, is private land and would only be acquired on a willing-seller basis. Twelve to 15 grazing allotments are all or partially included, but there would be no initial loss of AUMs.

The Park Service and BLM would cooperate in the management of the conservation area, with the Park Service taking the lead role in interpretive programs.

Discussion

This concept would provide a large area of national significance but would not establish a national park. The monument would remain essentially the same. The concept would not satisfy those who desire a national park or those who anticipate increased tourism due to national park status. The two areas would not be linked by a common name.

The Park Service would not be directly involved in the administration of the conservation area; there would be no conflict with area hunters and ranchers.

The national conservation area would include additional grasslands, which would provide needed diversity for recreational uses not available on the lava fields. However, elk are returning to Laidlaw Park and that area is being managed to preserve natural grasslands. Managing these lands for more diversified recreational use could lead to some future conflicts with the ranching and hunting groups.

Potential conflicts in administrative philosophy would be avoided (although the Park Service will always seek reasonably compatible administration of adjacent lands).

This alternative would not increase NPS administrative costs, but would require additional staff and funding to provide interpretive services in the conservation area. The added significance of the conservation area would require substantial additional funding and staff for BLM resource management and visitor services.

SUMMARY OF PUBLIC INVOLVEMENT

The six alternative management concepts in this document were presented at public meetings in Arco, Burley, and Pocatello, Idaho, in May 1990. More than 50 people attended the meetings; not all signed the register. No "votes" were taken, but there were those who opposed any change as well as those who supported some form of expansion. No new alternatives surfaced during the meetings, and none of the alternatives for expansion stood out as preferred.

The three public meetings brought out a range of reasons for and against an expansion of the monument. Those supporting expansion cited potential economic benefits and recognition of the area as nationally significant as primary reasons. The ability of the Bureau of Land Management to manage and protect the resources was questioned, with some saying the Park Service could do it better; others doubted the Park Service would have the staff and funding to do a better job.

Many people expressed concern for the safety of visitors in the expansion area, where temperatures hover over 100°, roads are rough and sometimes impassable, snakes are numerous, and there is no water. There was also concern that many existing primitive roads would be closed and that resources, particularly wildlife and vegetation, would be destroyed with increased visitation and development. Traditional uses, such as four-wheeling, biking, and hunting, would be eliminated or reduced in the expansion area.

Generally, ranching and hunting interests were against any change, although a few felt that an alternative similar to E might work. The issue of hunting in the lava fields limited support for any alternative banning hunting on lands under NPS administration.

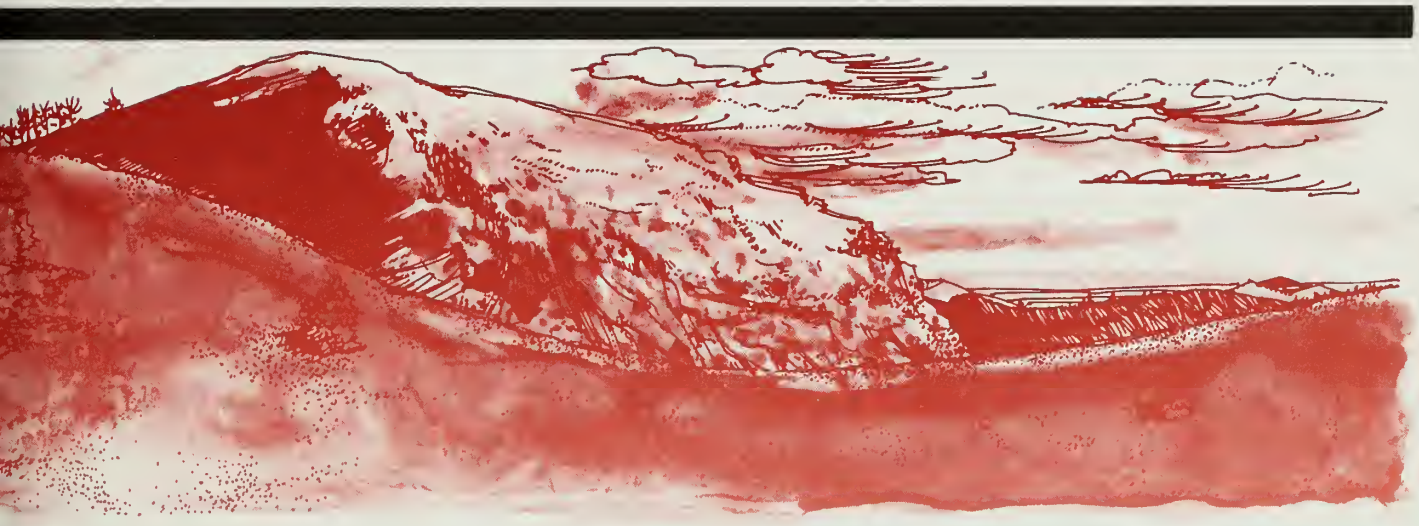
The Idaho Department of Fish and Game stated that "no real benefits to Idaho have been identified in the proposed change in management of this (these) area(s)." They are opposed to any additional lands in Idaho being added to the national park system.

Business/commercial interests generally supported some form of a major park; no alternative seemed to rise above the others, but there seemed to be a leaning towards alternative E with the option to include the Wapi Lava Field and ice cave under NPS administration.

Written comments received for 30 days after the meetings followed the same pattern as the comments at the meetings. Ranching and hunting interests remained generally opposed to any change in administration of the lands. Craters of the Moon Development, Inc., and its supporters came out in favor of a combination of alternatives B and E, with BLM administration of the preserve and boundaries that are close to those presented in the option in alternative E. The major changes to alternative E would be the inclusion of some of Big Southern Butte (and possibly the Cedar Butte Wilderness Study Area) under NPS administration and the exclusion of Huddle's Hole. Fourteen letters out of the 35 received supported this or a similar concept.

Eleven of those writing favored no action or nothing more than a name change for the monument. One favored implementing the BLM wilderness proposal, three favored the pending legislation, and three favored alternative E as it was presented in the document. One person just wants a highway built between Arco and Minidoka.

In summary, the alternatives study and public comment pointed out that legislation must be carefully drafted if the various interests are to support a park proposal; none of the alternatives will satisfy everyone. The meetings did help clarify problems with specifics of the pending legislation.



RECONNAISSANCE SURVEY

EXPANSION OF CRATERS OF THE MOON NATIONAL MONUMENT

RECONNAISSANCE SURVEY

EXPANSION OF CRATERS OF THE MOON NATIONAL MONUMENT

March 1989

U.S. Department of the Interior/National Park Service

SUMMARY

The National Park Service has completed a reconnaissance survey of the lands southeast and southwest of Craters of the Moon National Monument, Idaho, to determine if some of these areas could be recommended as additions to the present monument. An evaluation was conducted of the national significance of the resources in these proposed additions, and the suitability/feasibility of such a change in status was examined. Possible management strategies for the areas were also discussed but would require further analysis.

This reconnaissance survey concludes that, as a whole, the Great Rift system, the deepest known open volcanic rift on earth and the longest volcanic rift in the continental U.S., is nationally significant although many of the individual features are well represented in the national park system at Craters of the Moon National Monument and other units. The Great Rift system has integrity as a relatively unspoiled example of the natural forces shaping our planet and is of major scientific interest. Other features within the study area but outside the Great Rift system, including Big Southern Butte and Cedar Butte, were not concluded to be of national significance although they are interesting features of regional and local significance.

The Great Rift system would be suitable as an addition to the national park system. Its significant themes and features are considered underrepresented in the Columbia Plateau Natural Region and, under current BLM management policies, some of these resources are currently not adequately protected or adequately presented for public enjoyment. Pending wilderness designation would offer a high degree of protection to the major lava flows of the Great Rift under BLM administration, but not to other significant features of the Great Rift system such as the Open Crack and Kings Bowl rift zones and Bear Trap lava tube, which would continue to be administered under multiple-use policies.

The Great Rift system is feasible as an addition to the national park system; however, it lacks the diversity of features generally associated with a national park and would best fit in the category of national monument. Most of the land is in federal ownership and is of a size and configuration that lends itself to long-term protection and public use. However, depending on the boundary selected and management objectives, development and management cost could be quite high, and existing uses, such as grazing and hunting, would be eliminated under NPS management unless directed otherwise in the legislation.

Boundary expansion would not necessarily improve or expand the visitor experience, and it would not improve management of the existing monument. Management strategies other than expansion with NPS management could be in the best public interest and would provide suitable resource protection and improved opportunities for visitor use. Direct Park Service management is not required to accomplish these objectives. This approach would require some modification of current BLM management priorities and policies. Consideration should also be given to a concept similar to El Malpais in New Mexico, where a BLM national conservation area and NPS national monument are cooperatively managed. This concept would place needed emphasis on resource protection and visitor use while permitting traditional, compatible uses to continue.

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INTRODUCTION

PURPOSE

Expansion of Craters of the Moon National Monument has been discussed for nearly two decades. With the approach of the Idaho Centennial, there is strong interest by state citizens to expand the monument and designate the area a national park. At the request of Congressman Stallings, the National Park Service (NPS) initiated a study of adjacent areas for possible addition to the monument. In accord with the NPS planning process, a *reconnaissance survey* is the first step in evaluating a proposed addition to the national park system. The survey is a fact-finding effort based on readily available information and is used primarily to determine the significance of the area's resources, the degree of existing protection, and its suitability/feasibility for inclusion in the national park system.

To be eligible for favorable consideration as a unit of the national park system, an area first must be nationally significant. A natural, cultural, or recreational resource will be considered nationally significant if it meets all of the following criteria:

It is an outstanding example of a particular type of resource.

It possess exceptional value or quality in illustrating or interpreting the natural or cultural themes of our nation's heritage.

It offers superlative opportunities for recreation, public use and enjoyment or for scientific study.

It retains a high degree of integrity as a true, accurate, and relatively unspoiled example of a resource.

An area that is nationally significant also must meet criteria for suitability and feasibility to qualify as a potential addition to the national park system. To be suitable for addition to the national park system an area must

represent a natural/cultural theme or type of recreational resource that is not already adequately represented in the national park system, unless such an area is comparably protected and presented for public enjoyment by another land-managing entity.

Adequacy of representation will be determined on a case-by-case basis by comparing the proposed addition to other units in the national park system, considering differences or similarities in the character, quality, quantity, or combination of resources and opportunities for public enjoyment.

To be feasible as a new unit of the national park system, an area must

be of sufficient size and appropriate configuration, considering natural systems and/or historic settings, to ensure long-term protection of resources and to accommodate public use, and it must have potential for efficient administration at a reasonable cost.

Important feasibility factors include landownership, acquisition costs, access, threats to the resource, and staff or development requirements.

New additions to the national park system will not usually be recommended if other arrangements can provide adequate protection for the resource and opportunities for public enjoyment.

Alternative management strategies are generally evaluated after the determination of significance, suitability, and feasibility.

When a proposed addition to the system is an expansion of an existing unit, several other factors are considered:

- Are there significant related features in the potential additions not represented in the existing unit?
- Are these features now receiving adequate protection?
- Will additions or boundary adjustments improve the management of the existing unit?

If an area is determined to be of significance and meets the criteria for suitability/feasibility, it may merit further study to determine the best means of protecting and managing it; *a study of alternatives* report is then prepared. This report uses and elaborates upon the information contained in the reconnaissance survey and may require extensive fieldwork. The study of alternatives evaluates reasonable alternatives for the management, protection, and use of the area and analyzes the perceptual, economic, social, cultural, and environmental impacts of the alternatives. It is at this stage that possible boundaries and alternatives to fee acquisition and federal management are explored.

This reconnaissance survey will provide NPS management with basic information to determine whether the area merits further evaluation and development of alternative management strategies.

STUDY AREA

The study area (see Location map) includes a portion of the eastern Snake River Plain, a vast area of lava covering almost 10,000 square miles south, west, and east of the existing Craters of the Moon National Monument. The plain is a broad arc of low relief, occupying nearly one-fourth of the total area of Idaho and contrasting markedly with the mountainous terrain that dominates the north, central, and far southern parts of the state. Most of the study area is a shrub-steppe desert with almost no relief over miles of sagebrush grassland. Within this desert are a number of volcanic features including geologically recent lava flows with virtually no vegetation. The Snake River borders the southern and eastern edges of the plain, having been pushed into this channel by extensive lava flows during prehistoric times.

In a regional context, the study area boundaries generally extend to the edge of surrounding highway corridors, railroad routes, and population centers. The nearest population centers are Idaho Falls (pop. 39,590) and Pocatello (46,340) to the east, and

NORTH
0 20 40 60 80 100 MILES
LOCATION
CRATERS OF THE MOON NATIONAL MONUMENT
UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE
131 | 20,008A
DSC | FEB 89
COEUR D' ALENE
LEWISTON
Nez Perce
Nat'l Historical Park
IDAHO
Boise
Idaho Falls
Pocatello
Twin Falls
IDAHO
NATIONAL
ENGINEERING
LABORATORY
ARCO
CRATERS OF THE MOON N. M.
SHOSHONE
BLM DISTRICT
STUDY AREA
BOISE
IDAHO FALLS
IDAHO FALLS
BLM DISTRICT
BLACKFOOT
POCATELLO
SHOSHONE
Hagerman Fossil Beds
National Monument
RUPERT
TWIN
FALLS
BURLEY
BURLEY BLM DISTRICT
City Of Rocks National Reserve
SNAKE
RIVER

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TWIN
FALLS
BURLEY
BURLEY BLM DISTRICT
City Of Rocks National Reserve
SNAKE
RIVER

Twin Falls (26,209) to the south. Smaller towns are Arco (pop. 1,241) on the north and Shoshone (1,242) on the southwest. Blackfoot, American Falls, Rupert, and Burley are other population centers near the edge of the study area. With the exception of Arco and Shoshone, these population centers are along the Snake River.

The study area encompasses parts of Bingham, Blaine, Butte, Lincoln, Minidoka, and Power counties. Most of the study area is public land administered by the Bureau of Land Management (BLM). Three BLM districts are included (Idaho Falls, Burley, and Shoshone). (The Location map does not show current district boundaries due to the lack of information.) Privately owned lands occur primarily south and east of the study area, adjacent to the Snake River and along transportation corridors. The Idaho National Engineering Laboratory (INEL), under the Department of Energy, occupies a large tract of land on the northeast edge of the study area.

Agriculture and ranching are the economic bases. Irrigation water from the Snake River and wells allow production of potatoes, sugar beets, and wheat. There is also dryland farming of winter wheat. Cow-calf and ewe-lamb operations are the major types of ranching.

The area is underlain by the large (approximately 10,000 square miles), highly productive Snake River aquifer. Gravel lenses alternate with basalt underground. The basalt and gravel lenses absorb the water so there is no surface drainage flow across the extensive lava deposits.

The INEL is a major employer, and tourism is an increasing factor in the local economy.

Access/Transportation

Interstates 15, 86, and 84 on the south and east, US 93, 20, and 26 on the west and north, and US 26 on the northeast connect the population centers and provide the primary access to the area. Along the southern edge, State Highway 24 (paralleling the Union Pacific Railroad) connects Shoshone with Rupert by way of Minidoka and, to the east, State Highway 39 connects Blackfoot and American Falls by way of Aberdeen. Within this perimeter system of highways there are a few local paved spur roads and numerous primitive gravel and dirt roads, but there are no major roads.

The BLM maintains a gravel/dirt road into the Crystal Ice Cave area, the only "improved" road within the study area. A dirt/gravel road connects Arco and Minidoka, approximately 60 miles apart. This road is said to be impassable in the winter or during summer periods of heavy rain. Leading off this north/south route are literally hundreds of side roads and tracks. Tour buses from various places visit Craters of the Moon on a regular basis, but public transportation to the monument is not available.

Idaho Falls, Pocatello, and Twin Falls are served by scheduled airlines, and limited service is available to Hailey, near Sun Valley. Several small aircraft landing strips, generally located for access to livestock grazing areas, are within the study area. These strips were not examined.

Craters of the Moon National Monument

The 53,545.05-acre Craters of the Moon National Monument comprises the most diverse and geologically recent part of the lava terrane that covers the southern Snake River Plain. The monument contains examples of most of the major basaltic volcanic features in the Snake River Plain.

Wilderness/Wilderness Study Areas

There are 43,243 acres of designated wilderness within Craters of the Moon National Monument (Craters of the Moon Wilderness). In addition, there are several large tracts of public land under wilderness review in the study area. These tracts are currently administered as wilderness study areas (WSAs) by the BLM, which has made recommendations for or against wilderness designation and is waiting for Congress to act on these recommendations.

The largest tract under wilderness review, which nearly surrounds the monument, is the Great Rift WSA where BLM has recommended 341,000 acres for inclusion into the national wilderness preservation system. The area includes the Grassland Kipuka Natural Area (160 acres) and portions of the Craters of the Moon (267,950 acres) and Wapi (72,890 acres) lava flows. State lands within the proposed wilderness have been exchanged for other BLM lands, and there are no private lands.

The Raven's Eye WSA (67,110 acres of BLM land with 1,920 acres of state inholdings) and the Sand Butte WSA (20,792 acres of BLM land with 1,280 acres of state inholdings and an additional 1,751 acres adjacent to the WSA) have also been recommended for wilderness designation.

BLM has recommended that Cedar Butte WSA (35,700 acres of the Cerro Grande lava flow to the east and south of Cedar Butte), Shale Butte WSA (15,968 acres of BLM-administered land with no inholdings), Bear Den Butte WSA (9,700 acres of BLM land with no inholdings), and Little Deer WSA (33,531 acres of BLM land with 640 acres of state inholdings) not be recommended for wilderness designation.

VOLCANIC FEATURES OF THE STUDY AREA

The volcanic features in the study area are the major features being evaluated in this reconnaissance study. Prominent volcanic features in the study area include: the Craters of the Moon, Open Crack, Kings Bowl, and Wapi rift sets*, which together make up the 65-mile Great Rift system; the Craters of the Moon, Wapi, and Kings Bowl lava fields associated with the Great Rift; Craters of the Moon National Monument; Bear Trap lava tube; Crystal Ice Cave; Big Southern Butte; and Cedar Butte and the Cerro Grande lava flows. These features are described below. Other resources of the study area are described in appendix A. Although the national monument contains various volcanic

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*A volcanic rift set is a weak spot in the earth's crust that is manifested by a series of parallel cracks or noneruptive fissures, eruptive fissures, cinder cones, lava cones, spatter cones, etc.

features, some notable features – including most of the Great Rift system – are outside the monument boundary (see Physical Resources map).

The Great Rift, 13 miles of which are in the monument, has been studied by scientists since the early 1920s. At 65 miles, this is the longest volcanic rift zone in the continental United States. The Great Rift system is composed of four smaller rift zones – the Craters of the Moon Rift Set, the Open Crack Rift Set, the Kings Bowl Rift Set, and the Wapi Rift Set. Lava poured from some of the vents and fissures to form large flows. When there were repeated episodes of lava flows over the years or centuries, the flows piled on top of one another to form the vast Craters of the Moon and Wapi lava fields. These Great Rift lavas illustrate the variety of forms and constructs possible in basaltic flows, including spatter cones, hornitoes, driblet spires, tree molds, lava tubes, lava bombs, collapse depressions, squeeze-ups, pressure ridges, cinder cones, and aa, pahoehoe, and blocky pahoehoe lavas (see appendix B for a description of these features). The only missing feature is active volcanism such as that found in Iceland and Hawaii.

The Craters of the Moon lava field on the northwestern part of the Great Rift shows evidence of at least eight eruptive periods, which began about 15,000 years ago and ended about 2,000 years ago. This field consists of more than 60 lava flows that erupted from about 25 cinder cones and more than eight eruptive fissure systems. Covering about 617 square miles, it is the largest basaltic lava field of dominantly Holocene age in the contiguous United States. The Great Rift in the Craters of the Moon field is marked by a line of cinder cones, spatter cones, and lava features that define the eruptive fissures. The fissures in the Craters field are not exposed as open cracks as they are farther south in the Open Crack Rift Set. Some fissures in the Great Rift, such as the fissures in the Open Crack Rift Set, are noneruptive – no lavas issued from them.

The Kings Bowl, a flow covering about 1.3 square miles, erupted from a single 4-mile fissure. It contains fissure-fed pahoehoe lava flows, lava lakes, low natural levees, spatter ramparts, spatter cones, and explosion pits. The Kings Bowl lava field also contains the deepest known (800 feet) open volcanic rift in the world.

Unlike the Craters or Kings Bowl fields, the Wapi lava flow forms a low shield volcano.* The Wapi lava field is separated from the Craters of the Moon flow by about 10 miles of sagebrush grassland. The 160-square-mile Wapi field (about one-fifth the volume of the Craters flows) is among the best preserved low shields on the Snake River Plain. Pillar Butte, a spatter rampart about 60 feet tall, marks the vent region for the Wapi flow. The Wapi flow is characterized by pahoehoe and aa flows, pressure plateaus, flow ridges, and collapse depressions.

The Kings Bowl and Wapi lava fields are about the same age as the youngest of the Craters flows. Although the Craters of the Moon lava field is a compound field made from

*Shield volcanoes have a broad, rather elliptical base with low gradually sloping sides and a steeper slope to the summit of the cone. They are built from fluid lavas that are erupted at relatively high rates of effusion and involve essentially the same vent or vent system repeatedly. Low shields are given that name to distinguish them from shield volcanoes like those of the Hawaiian Islands, which are built up from the bottom of the ocean.

multiple eruptions over the centuries, the Kings Bowl and Wapi lava fields are the products of single eruptive bursts that were relatively short-lived.

Another volcanic feature in the study area, the Open Crack Rift Set, has numerous 4- to 8-foot-wide open fissures in the earth where no lavas poured forth. The two main sets of fissures are roughly parallel, about 6,000 feet apart, tens of meters deep, and extend for about 13 miles. Only open cracks define the Great Rift in the Open Crack Rift Set area, instead of lines of cinder cones, spatter cones, and eruptive fissures as in the Craters of the Moon Rift Set. The Open Crack area is a shrub-steppe desert (sagebrush grassland) developed on old lava flows.

Crystal Ice Cave, southeast of the monument, is 150 feet below the surface within the Great Rift in Kings Bowl lava field. Ice is a common feature in the holes and caves in lavas in areas that receive winter snow. Snowmelt and runoff water in the depressions freeze during the winter and remain frozen because of the excellent insulating properties of the lava and because cold air sinks to maintain low temperatures. At one time, the ice formations at Crystal Ice Cave were said to rival anything of their kind in massiveness and aesthetic beauty. A recent inspection of the cave showed the formations to be much reduced in size and beauty. The reason for the diminution of the ice is unknown. Construction of access tunnels has undoubtedly altered the natural conditions in the cave.

Black Top Butte (called Blacktail Butte on some maps), southeast of the monument, is a complex vent area with lava lakes and pit craters not commonly found elsewhere in the Great Rift system. Devil's Cauldron was a major vent area at one time, but only the remnants remain. A geologically interesting feature is that the fissures at Black Top Butte are superimposed across Devil's Cauldron. Black Top Butte is the best example of an eruptive fissure system in the Great Rift. The best examples of spatter ramparts in the Great Rift system are northwest and southeast of Black Top Butte.

Split Butte is one of the most unique features on the Snake River Plain. It is about 8 miles west of the Kings Bowl flow, adjacent to one of the northwestern arms of lava extending from the Wapi flow. The butte consists of an outer cone of volcanic fragments that encloses an inner lava lake and pit crater. A "split" or gap about 300 feet long occurs in the eastern section of the cone. The butte is thought to be a maar crater, which formed by an explosion resulting from the generation of steam from the interaction of groundwater with erupting magma.

The 5,800-acre Big Southern Butte is the most prominent landmark in the eastern Snake River Plain, rising over 2,000 feet above the surrounding plain. Big Southern Butte is more closely allied geologically with Middle and East buttes, two other rhyolitic domes to the east, than to the basaltic lava fields of the Great Rift. The butte is about 300,000 years old, but the geological history is complicated and not well understood. It consists of two coalesced domes, and the chemical composition of each dome differs as well as the ages of the rocks within each dome. The butte is primarily rhyolitic but there are basalt inclusions.

Cedar Butte and the nearby Cerro Grande lava flow are east of Big Southern Butte. Cedar Butte, an unusual volcanic complex on the Snake River Plain, is an andesitic lava cone, with flows covering about 10 square miles. The vent area consists of a circular cone and an arcuate vent. The two vents were active at different times; the cone is younger. A flow from Cedar Butte has been dated at about 400,000 years old.

LAVA FIELDS

STUDY AREA BOUNDARY

DIRT ROAD

0 1 2 3 4 5 6 MILES

NORTH

PHYSICAL RESOURCES

CRATERS OF THE MOON NATIONAL MONUMENT

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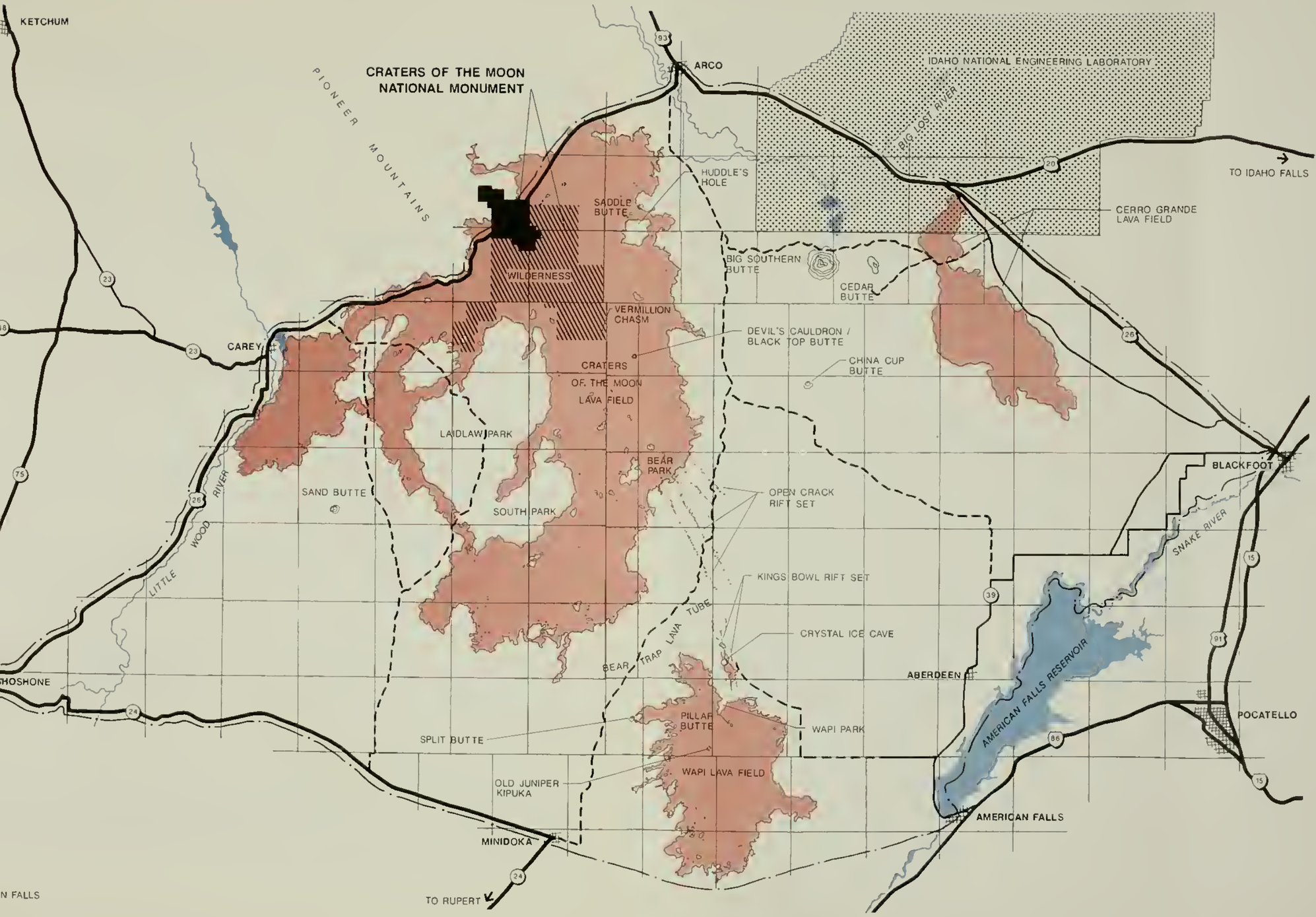

PHYSICAL RESOURCES

CRATERS OF THE MOON NATIONAL MONUMENT
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Although the Cerro Grande flow is near Cedar Butte, it is basaltic and of much more recent origin (about 13,000 years ago) than the Cedar Butte flow. The Cerro Grande flow covers about 75 square miles and originated from a fissure 6 miles southeast of Big Southern Butte.

The longest lava tube system in the area, including its collapsed and open sections, is the 12-mile Bear Trap lava tube system. Bear Trap Cave is an uncollapsed section of the Bear Trap lava tube.

Kipukas are vegetated areas on top of older lava flows that were not inundated by the most recent lava flows. Most kipukas are higher-elevation remnants of earlier volcanic activity, either cinder cones, craters, or lava shields. The kipukas are generally covered with low-growing vegetation in various successional stages and occasional trees. Carey, Old Juniper, Huddle's Hole, Bear Park, Laidlaw Park, and Little Park are some of the larger kipukas in the study area.

SOCIOECONOMIC ENVIRONMENT

Much of the regional economy is based on agricultural supply and processing, although high-tech industries are expanding. Livestock operations represent the major economic base of the study area.

Agriculture is limited within the study area because of the lack of surface water, amount of rock outcrop, short growing season, and shallow unsuitable soils. Agricultural lands are concentrated where irrigation water is available in the southern portions of the study area near Minidoka and east of Minidoka to the Wapi flow, in the lands east of the Wapi flow and west of American Falls, and along the Little Wood River between Carey and Shoshone. Alfalfa, barley, winter wheat, and potatoes are the major crops in the study area.

The INEL, a 570,000-acre complex, employs over 10,000 people at peak times, including nearly 2,000 engineers and scientists conducting research ranging from space and defense projects to alternative energy testing. Another major thrust is technical problem solving for private companies, communities, and universities. The regional economy benefits through salaries, hundreds of millions of dollars of purchasing, and the creation of new businesses with the commercialization of new products and processes.

Tourism currently represents a very small part of the economic base in the study area. Arco probably receives the most benefit from tourism because of its proximity to Craters of the Moon. Sun Valley and the Sawtooth National Recreation Area to the west and Yellowstone/Grand Teton national parks to the east are major tourist destinations.

Land Use

Grazing. Cattle and sheep grazing is the major use of public land in the study area. Grazing is controlled by the allotment system. Allotments are based on the amount of use, the amount of land allotted, the season of use, and the type of grazing system used. Where cattle graze, their areas of use have been fenced to restrict livestock movement and allow implementation of grazing systems (see Landownership and Land Use map).

There are 22 allotments that border lava flows and could potentially be affected by expansion of the monument; more than 100 operators could be affected.

According to the Idaho Falls BLM District Office, approximately 30,000 sheep are trailed through the sagebrush grassland between the Craters of the Moon and Wapi lava flows in the spring and fall.

Minerals/Mining. There are no known natural gas, oil, or mineral deposits in the Great Rift WSA. According to BLM reports, there is a low potential for oil and gas, geothermal resources, and metallic and nonmetallic minerals in the study area. The area is considered to be within the Laramide over-thrust belt, although it is covered with thick layers of basalt. This belt has attracted leasing interest but has produced no oil or gas in Idaho to date. The greatest demand for mineral material is for cinders that the highway department uses for road base.

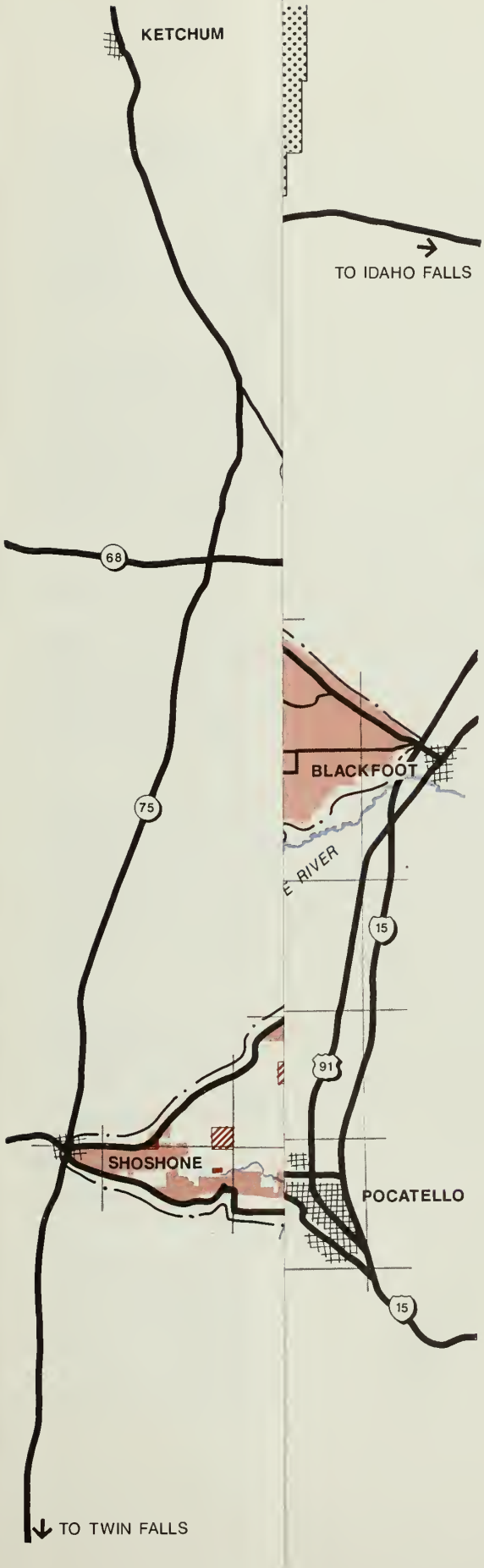
BLM-administered lands are open to mineral leasing and exploration for oil, gas, and geothermal resources with restrictions that exploration on the WSAs not impair the suitability of those areas as wilderness. Any adverse impacts due to mineral entry on public lands must be mitigated in accordance with applicable regulations. Areas of particular concern are sage grouse strutting and nesting grounds, slopes over 15 percent, and soils susceptible to wind erosion. No surface occupancy is allowed in conjunction with mineral leasing and exploration on Saddle Butte, China Cup Butte, Big Southern Butte, and Quaking Aspen Butte on the east side of the Great Rift. In the Shoshone BLM district there are 24,000 acres currently under oil and gas lease, but no activity has taken place on the leases. There are valid existing rights to 17,026 acres of oil and gas leases on the Cedar Butte WSA. Leasing is anticipated to continue, but exploration activity is not anticipated. There are approximately 320 acres of mining claims within the Shale Butte WSA.

There are no geothermal leases in the study area. However, a large area east of Carey encompassing the Craters of the Moon and Wapi lava flows is considered to have some potential for geothermal resource development. BLM identified the area as speculative. There are numerous hot springs scattered throughout the Snake River Plain that indicate the geothermal potential of the general area.

No geothermal resource development has occurred, and exploration by major energy companies has proven unsatisfactory.

The potential for locatable minerals in the study area, primarily gold, silver, and molybdenum, is low. However, there is a potential for locatable minerals in the Lava Creek area of the Pioneer Mountains north of the existing monument close to the border of the study area. There are several unpatented claims along the northwestern boundary of the existing monument. Most of the interest in gold is centered along the Snake River. There is potential for molybdenum at Big Southern Butte.

BLM-administered lands are open to extraction of saleable minerals, with the exception of the WSAs, Big Southern Butte (except the public cinder pit), Saddle Butte, and Quaking Aspen Butte. Lava building stone, cinders, and various types of gravels, sand, and common borrow are present in the study area. There are several deposits of these materials in the study area on the west side of the Great Rift. They are near the roads and railroad that bound the study area and would probably not be affected by monument expansion. On the east side of the Great Rift, there is a public cinder pit near Big



BLM LAND, MULTIPLE USE

BLM WILDERNESS STUDY AREA

STATE SCHOOL SECTION

WITHDRAWN LAND

PRIVATE LAND

STUDY AREA BOUNDARY

DIRT ROAD

0 1 2 3 4 5 6 MILES

NORTH

LANDOWNERSHIP AND LAND USE

CRATERS OF THE MOON NATIONAL MONUMENT

UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE

131	20,009A
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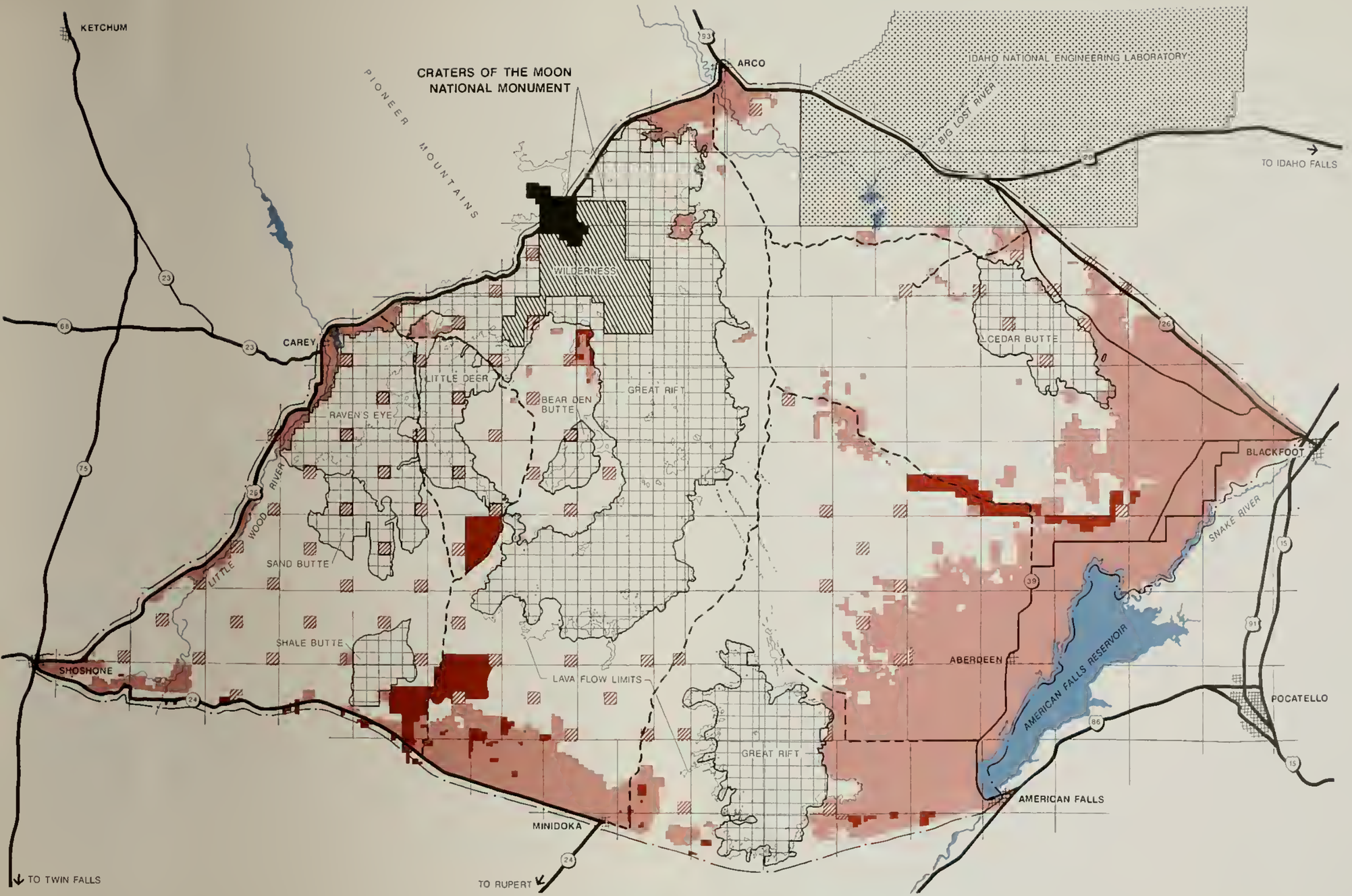

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Southern Butte. There is no other publicly owned pit closer to Idaho Falls. Sand/gravel deposits are most common along the Little Wood River on the northwest boundary of the study area and along the Snake River on the southeast boundary. Lava building stone is found all over the Snake River Plain, with deposits both in and out of the potential expansion area. Six building stone placer mining claims, covering 454 acres, are near the northwestern boundary of the Cedar Butte WSA. Of the 454 acres, 25 acres contain locatable quality stone. Development of the 25 acres is highly likely.

Management Uses. Big Southern Butte is used by BLM as a fire lookout and a communications site. BLM maintains a right-of-way reservation of 28.87 acres of roadway and 30 acres for the site itself. The fire lookout is used for fire detection on lands managed by the INEL, the Forest Service, and the National Park Service, as well as on BLM lands. A repeater for the Idaho Falls BLM District, which provides important radio coverage for the area, is on the site. The fire lookout radio system and an Idaho Fish and Game repeater also occupy the communications site.

Landownership

Within the study area, there are public lands administered by the BLM, the National Park Service, and the state of Idaho. There are also parcels withdrawn for military use, land administered by the INEL by a permit from the BLM, and private land (see Landownership and Land Use map). (State school sections in the process of being acquired or exchanged are not shown on the map.)

Most land in the study area is public land administered by the BLM. The National Park Service manages 53,546.05 acres at Craters of the Moon National Monument. State lands are generally sections 16 and 36. Within the Great Rift WSA, all the state lands have been exchanged. There are other state sections within the study area that BLM is in the process of exchanging to consolidate boundaries for ease of management. There are several parcels of land withdrawn for military use on the west side of the study area. The INEL controls the land in the northeastern corner of the study area.

The private lands in the study area are usually along stock allotment boundaries adjacent to croplands and are concentrated on the edges of the study area near the roads. There are large tracts of private land north of the railroad at Minidoka, on the eastern portion of the study area from the east side of the Wapi flow along the Snake River to Blackfoot, along highway 26/93 between Shoshone and Carey, and along the highway near Arco.

There are other parcels of private land scattered throughout the rest of the study area. The following private lands border the lava flows: 1,671 acres of private land within the Craters of the Moon lava flow at Huddles Hole; an undetermined amount near Arco bordering the extreme northeastern portion of the Craters flow; approximately 1,300 acres in Paddleford Flat; about 1,000 acres in Laidlaw Park; an undetermined amount near Carey bordering the westernmost portion of the Craters flow; 900 acres near Pratt Butte; and an undetermined amount bordering the Cerro Grande flow. There are also parcels of private land near Packsaddle and Antelope buttes south of Big Southern Butte and at Frenchmans Spring northwest of Big Southern Butte.

SIGNIFICANCE

Before a new area can be proposed for inclusion in the national park system, it is evaluated for significance. Significance of a proposed area relates to themes contained in the *National Park System Plan* (1972), which divides the country into natural regions based on Fenneman's *Physiographic Divisions of the United States*. The plan further identifies natural history themes for each of these regions. An objective of the plan is to present significant themes so that areas representing the themes can be identified and included in the national park system.

The study area is in the Columbia Plateau Natural Region. Two natural history themes of this region, "Sculpture of the Land" and "Works of Volcanism," are considered of prime significance for representation in the national park system. However, only the latter is applicable to the study area. (The regional themes and the features applicable to the study area are shown in appendix C in greater detail.) The "Works of Volcanism" theme is well represented in the national park system, but is considered under-represented in the Columbia Plateau Natural Region primarily because Craters of the Moon National Monument contains only some of the outstanding volcanic features of the Snake River Plain.

RELATIONSHIP OF THE GREAT RIFT SYSTEM TO THE NATIONAL PARK SYSTEM

All types of volcanism, from ancient to recent, are represented in the national park system. Volcanic eruptions take several forms. Fissure eruptions, in which great volumes of basaltic lava ooze rather than explode and spread out to form vast lava plateaus, are termed Icelandic. When both fissure and central eruptions occur, and the eruptions are moderately active, the eruptions are termed Hawaiian. Extremely violent eruptions that cause extensive damage, such as at Mt. St. Helens, are at the opposite end of the spectrum of volcanic activity.

At Hawaii Volcanoes National Park, visitors can see volcanism in process. Mt. Rainier and Crater Lake national parks are classic examples of a different type of ancient volcano. In areas such as Chiricahua and Devils Tower national monuments, most visitors would not recognize that the rocks were formed by volcanic processes without the interpretation provided by the Park Service.

Because volcanism is well represented in the national park system but is considered inadequately represented in the Columbia Plateau Natural Region, the next question is would expansion of Craters of the Moon National Monument amplify interpretive values or transcend the resource values of the existing monument? Craters of the Moon National Monument represents a form of Icelandic/Hawaiian volcanism characterized by quiet lava flows. There are four other NPS areas in which basaltic lava flows are a primary feature of the volcanic activity that occurred – Hawaii Volcanoes National Park and Sunset Crater, El Malpais, and Lava Beds national monuments.

All the volcanic products seen in the Great Rift system can be seen today in the process of formation at Hawaii Volcanoes National Park, although cinder cones are very rare at Hawaii Volcanoes. There are even ice caves in lava tubes at high elevations. Kilauea and Mauna Loa are shield volcanoes like the Wapi flow, but on a scale that is orders of magnitude greater. The Mauna Loa shield volcano rises 30,000 feet from Pacific Ocean

floor; the Wapi flow is about 300 feet thick at its vent area and less than 100 feet thick over most of the flow. The end results of the processes occurring now at Hawaii Volcanoes are expressed in the Great Rift system on a scale that can be seen and appreciated in a few hours or a day; however, the Great Rift system is not as spectacular as the ongoing eruptions.

Sunset Crater National Monument in northern Arizona contains a large multicolored cinder cone, with associated lava flows that erupted about A.D. 1065. The area does not compare with the size of the fissures and flows and the variety of volcanic products seen in the Great Rift system.

El Malpais National Monument in west-central New Mexico was added to the park system in 1987. The 12 lava flows of El Malpais contain all the volcanic features found in the Great Rift system, although the flows are of less volume. The most recent flow in El Malpais occurred about 700 years ago versus 2,000 years ago in the Great Rift system. El Malpais, with at least 50 lava tubes (some of which may be open for public use), is much richer in lava tubes than the Great Rift system. El Malpais also has five spectacular ice caves, one of which has potential for visitor use.

Lava Beds National Monument is in northeastern California on the flank of the Medicine Lake volcano, a Pleistocene shield volcano. The Medicine Lake Highlands, administered as a scenic area by the Forest Service, contain the best examples of rhyolitic lava flows in the continental U.S. Lava Beds National Monument contains some of the recent (500-1,100 years old) basaltic lava flows and cinder cones that are part of this shield volcano. Only part of one of the major aa flows lies within the monument boundary. Lava Beds is notable because of its several hundred known lava tubes, about 100 of which contain water and/or ice. A few of the ice caves contain spectacular and beautiful ice formations, and even an ice river.

Craters of the Moon National Monument contains some of the best and most varied of the volcanic products associated with a basaltic fissure eruption. The features of the existing monument, however, are only a part the Great Rift system. Compared to the four NPS areas containing examples of recent basaltic lava flows, the Great Rift system has the best examples of a recent purely basaltic fissure eruption and its associated volcanic products; it also contains an excellent example of a noneruptive fissure system (the Open Crack Rift Set). The Great Rift system is the longest volcanic rift in the continental U.S. and the deepest open volcanic rift on earth (800 feet at Kings Bowl). This portion of the Great Rift system is thus of international significance.

The Great Rift system also offers the best example in the world of one of the major types of basaltic volcanism on a scale that can be appreciated in a short time and that is in an accessible location. Unlike Hawaii, where the volcanic products are spread over a large area, the features of the Great Rift system occur in a single, relatively compact area. The same type of volcanism also occurs in Iceland, but again the scale is larger and the access obviously more difficult. The Great Rift system is significant because it is well known and well studied geologically, the first major scientific work appearing in the 1920s and continuing to the present. Although outstanding features of basaltic volcanism are included in the existing monument, some are outside the boundaries. The features within the monument present only a partial picture of the Great Rift system.

Crystal Ice Cave, outside the monument, is nationally significant because it is a fissure cave rather than a lava tube cave. However, the distinction between a fissure cave and

a lava tube is not readily apparent while you are in the tunnel at the cave. At one time, Crystal Ice Cave was felt to be of national significance, hence its inclusion in the Great Rift National Natural Landmark. This designation is reserved for areas that, in the opinion of the secretary of the interior, are nationally significant as the best representatives of the nation's major biotic communities or geologic features. However, the cave has been significantly altered to permit visitation. The ice formations are much reduced in size and beauty and no longer compare with the ice caves at Lava Beds and El Malpais national monuments. Crystal Ice Cave alone does not transcend the Lava Beds ice caves in resource value, but its interpretive value as a fissure cave is nationally significant.

Black Top Butte, outside the monument, is the best example of an eruptive fissure system in the Great Rift. The best examples of spatter ramparts in the Great Rift system are northwest and southeast of Black Top Butte. The Vermillion Chasm area in the monument is also an eruptive fissure system and contains spatter ramparts, but it is in the Craters of the Moon Wilderness and access is difficult. Black Top Butte is closer to the edge of the lava and more easily accessible. It is regionally significant with respect to the "Works of Volcanism" theme.

The Wapi lava flow contains some geological features not found in the Craters of the Moon flow – hornitoes, driblet spires, and small lava constructs (a few feet tall) as opposed to the larger spatter cones of the Craters flow. Regionally, the most significant feature of the Wapi flow is that it is the youngest and best preserved example of a shield volcano on the Snake River Plain. There are other shield volcanoes in the national park system, notably in Hawaii Volcanoes National Park, but these are not low shields like the Wapi.

Bear Trap lava tube, northwest of the King's Bowl, is the longest and best example of a lava tube in the Great Rift area and is thus regionally significant. The tube can be traced for more than 12 miles by a series of collapsed segments; it ranks among the longest known nationally. The longest known intact lava tube (12,810 feet) is Ape Cave in Mt. St. Helens National Monument, administered by the Forest Service.

Other Volcanic Features of the Study Area

Big Southern Butte, an endogenous rhyolitic dome, is geologically intriguing because it represents a different type of volcanism and is much older than the nearby basaltic flows of the Great Rift system. Big Southern Butte, a national natural landmark, is more significant as a natural and cultural landmark than for its geological relationship to the Great Rift system. The butte served as a landmark for pioneers following the Oregon Trail. It has regional significance today, standing as a landmark above the low relief of the lava flows. The butte is not considered a significant volcanic feature with respect to the *National Park System Plan.*

Cedar Butte, southeast of Big Southern Butte, is not unique structurally nor does it contain any significant features that relate to basaltic volcanism. The rocks are of a unique chemical composition, but are not of wider interest geologically.

The Cerro Grande lava flow close to Cedar Butte is an example of a young, single flow, but is not unique in any other way. It is not significant with respect to the *National Park System Plan.*

The regional significance of China Cup Butte, an almost perfectly circular cinder/scoria cone in the eastern portion of the study area, lies in the regularity of its shape, but is not significant with respect to the *National Park System Plan*.

Split Butte is of regional significance as a maar crater and for its unique construction. Sand Butte is also a regionally outstanding example of a maar crater. The Ubehebe Craters in Death Valley National Monument are examples of maar craters that are already included in the national park system.

Summary of Significance

The Great Rift system is of national significance as the longest volcanic rift zone in the continental U.S. and the deepest known open volcanic rift zone on earth. The rift provides an outstanding and accessible example of the major forces of basaltic volcanism on a scale that can be appreciated. According to Mel Kuntz, Geological Survey, it is the best place in the world to show examples of basaltic volcanism. Although specific volcanic features are comparable to resources found in other NPS areas, the Great Rift system presents all the major features of basaltic volcanism in a single, relatively compact area and is of major scientific interest.

The rift area has seen relatively little use and, with the exception of Crystal Ice Cave and the developed area of Craters of the Moon National Monument, has integrity as a relatively unspoiled example of the natural forces shaping our planet.

Although there are features of scientific and public interest other than the Great Rift system within the study area, these features are relatively common and are not considered to be of national significance. Big Southern Butte is primarily of local and regional significance as a natural and cultural landmark.

EXISTING PROTECTION

General Comments

National natural landmark (NNL) status confers no protection on Great Rift NNL or Big Southern Butte NNL. To protect the ecological characteristics of Big Southern Butte, BLM has closed the area to ORV use, grazing, and surface occupancy for mineral leases.

Most of the study area is administered by the BLM under multiple-use policies. Although specific resources have been designated for special protection, management policies are subject to change and the protection of significant resources cannot be ensured. Areas such as the major lava fields are relatively self-protecting because of the difficult access across the rough surfaces.

The BLM wilderness study areas (Great Rift, Cerro Grande, Shale Butte, Bear Den Butte, Little Deer, Raven's Eye, and Sand Butte WSAs) are administered under the Interim Management Policy and "Guidelines for Lands under Wilderness Review." Although some development activities are permissible on lands under review for wilderness designation, these activities are subject to important limitations and must be carefully regulated under BLM policy. This policy requires that the land be administered in such a manner as not

to impair the suitability of the area for wilderness. Exceptions to the nonimpairment policy are made for existing mining, mineral, and grazing leases. (These existing uses are restricted to the "same manner and degree" as they were on October 21, 1976, the date of the Federal Land Policy and Management Act.)

If Congress designates the WSAs as part of the national wilderness preservation system, BLM would develop a comprehensive wilderness management plan. Until such a plan is developed and implemented, such uses as commercial development, permanent roads, temporary roads except as necessary for administration of the area, the use of motorized equipment and mechanical transport, and structures or installations within the area are prohibited. If the lands are designated as wilderness, the minerals would be withdrawn from all forms of appropriations under the mining laws and from disposition under all laws pertaining to mineral leasing, subject to valid existing rights. Geothermal exploration would be allowed in the Great Rift WSA under a stipulation of "no surface occupancy." Under the Wilderness Act of 1964 (section 4 (d) (1)), which allows the use of aircraft where the use is already established, the present aerial predator control policy could continue.

Areas outside the proposed wilderness boundaries (such as the Open Crack and Kings Bowl rift sets) are protected only by the existing multiple-use policies.

If the proposed wilderness areas are withdrawn from wilderness consideration, BLM would administer them under general policies of multiple use and sustained yield in such a way as to prevent unnecessary or undue degradation of the lands. Grazing allotment management plans emphasize measures to protect soils, watersheds, and wildlife habitat. Generally, public recreation and interpretation of significant natural and cultural features receive secondary emphasis in the study area.

Until action is taken on wilderness, all public lands in the study area will be kept open to mineral leasing and exploration. The policy of the BLM Idaho Falls District Office allows no surface occupancy associated with mineral leasing and exploration on Big Southern, China Cup, Saddle, or Quaking Aspen buttes. Geothermal leasing is allowed north and west of the Craters of the Moon flows only in accordance with interim management guidelines for WSAs; no surface occupancy is allowed. Although the lands are open to mineral entry, regulations are applied to mitigate adverse impacts. Areas of particular concern are the sage grouse strutting and nesting areas, Big Southern Butte, the Great Rift WSA, China Cup Butte, Saddle Butte, Quaking Aspen Butte, Kings Bowl, Cedar Butte, slopes over 15 percent, and soils subject to wind erosion. The entire portion of the study area administered by the BLM Idaho Falls District Office is open to salable materials (lava building stone and cinder pits) except for the Great Rift and Cedar Butte WSAs and Big Southern, Saddle, and Quaking Aspen buttes.

Plans have been made but no action taken to protect cultural resources under the jurisdiction of the Idaho Falls BLM District Office. Eleven sites have been allocated for surface erosion data collection, 27 sites for data collection related to unauthorized surface collection, 15 sites for future scientific use, 2 sites for scientific surface collection/test excavations, and 17 sites for systematic surface collections. Thirty-six sites will be protected by patrols.

Summary of Existing Conditions

Major portions of the Great Rift system are proposed for wilderness. Designation of these areas as wilderness would ensure the long-term protection of significant resources. However, significant resources such as the Open Crack Rift Set, Kings Bowl, Crystal Ice Cave, and Bear Trap lava tube are outside the proposed wilderness areas and are only protected by existing multiple-use management policies, which are subject to change.

THREATS TO THE RESOURCE

Existing Resource Damage

The major resource damage that has occurred in the study area is the alteration of the species composition of the shrub steppe vegetation through livestock grazing and fires. There has been no significant damage or alteration to the lava flows.

With little on-site protection, many features in the study area are subject to vandalism or inadvertent damage. The BLM staff and funding are insufficient to ensure protection of the various natural features in the study area. Fortunately, many features are extremely remote and relatively little known.

At Kings Bowl, lithic blocks scattered on the surface on the east side were pushed into the open fissure before the area was designated in the Great Rift National Natural Landmark. The lithic blocks on the west side escaped damage because access was more difficult. The trail into Kings Bowl is eroding, and access is rather dangerous.

At Crystal Ice Cave, the 1,200-foot access tunnel, the electrical lighting, and the viewing windows have significantly altered the integrity of the resource.

Potential Threats

Improved access, particularly a major road through the area, would constitute the single largest threat to study area resources in general. ORV use would likely increase, wildlife poaching could increase, and the potential for casual pot hunting, surface collecting, and other forms of cultural vandalism would increase with improved access. A major road would also have a potential to attract commercial enterprises and lead to the privatization of lands along the road corridor. Some of these uses might not be compatible with resource protection objectives.

The potential for invasion by exotic and noxious weeds would increase with improved access and development. Weedy species tend to colonize an area from propagules brought in on people and equipment. Exotic plants threaten native range plants through competition for moisture and nutrients and tend to increase in overgrazed areas.

In general, the lava crust is fragile. Areas where the black surface rock has been disturbed are distinguished by the exposed dull reddish surface. In some places, a thin crust covers a hole; a visitor walking on the lava can damage the surface or fall through the crust.

Grazing is generally not allowed in NPS areas unless specified in the legislation. If prohibited in an expanded monument, there would be a problem of livestock trespass. Although the lava fields are protected from livestock trespass by the rough nature of the surface, the shrub-steppe vegetation at the edge of the lava fields would be at risk unless the boundary was fenced. Fencing to prevent livestock trespass would adversely affect the movements of antelope.

The major conflict between livestock use and other resources is the impact on the stability of sandy soils. Livestock may influence the quality of wildlife habitat in localized areas.

A small percentage of known cultural resources have been damaged by livestock trampling. The most notable loss is the remains of the Big Butte Stage Station at Big Southern Butte. Trampling also indirectly threatens cultural remains by increasing the erosion potential around the resource.

The biggest threat to plant and animal resources is the frequent wildfires. Improved access and increased visitor use could lead to an increase in fires. Fires reduce stands of mature sagebrush, which is the most important wildlife habitat and has the greatest species diversity in the study area. Cheatgrass, a weedy species well adapted to fire, replaces native grasses and forbs. Burrowing owls, a sensitive species, are the only species that appear to benefit from the burned habitat.

Loss of historical winter range on the southern edge of the study area through conversion to agricultural land has affected sage grouse and big game species. The animals are forced to winter farther north, where the snow is deeper and the frequent wildfires have reduced brush cover.

Sage grouse strutting grounds are critical. Improved access could cause additional stress to the birds by allowing people access to the strutting grounds.

There is a potential in the study area for right-of-way demands for utility projects, powerlines and customer service lines, communications sites on the buttes, road access, pipelines, ditches, and canal crossings. Much of the demand is tied to agricultural or residential development, so the potential for affecting the lava flows is low.

Air quality could be damaged by emissions from a coal-fired power plant at INEL as well as other industrial emissions. There is some potential for a nuclear accident at INEL, and there is concern that nuclear waste storage could threaten the aquifer and other water supply. Because the work at INEL is classified, little is known about potential environmental hazards. Recent testimony has shown public concern about proposals to build four new nuclear reactors at the laboratory and secrecy about clouds of radiation that are rumored to be released from weapons plants and laboratories.

Summary of Threats to the Resource

Major portions of the Great Rift system are proposed for wilderness. Designation of these areas as wilderness would ensure the long-term protection of significant resources. However, significant resources outside the proposed wilderness areas are only protected by existing management policies, which are subject to change.

A significant increase in visitor use, unless carefully regulated, poses a potential threat to study area resources. Damage to lava surfaces, increased vandalism, poaching, increased wildfires, and artifact collection are major concerns. Improved access could lead to commercialization and privatization of adjacent lands, resulting in decreased wildlife habitat and possible vegetation changes.

SUITABILITY/FEASIBILITY

SUITABILITY

The Great Rift system contains examples of basaltic volcanism similar to those found in other units of the national park system. The major values of the Great Rift system are the geologic features and the primitive character of much of the area, its integrity as a relatively unspoiled resource, the diversity of its features, and its relatively compact size, which allows outstanding opportunities for scientific study and interpretation. These attributes transcend the fact that many of the features are represented in the system.

Major features of the Great Rift system, including the Open Crack Rift Set and the deepest known open volcanic rift in the world, are not adequately represented in the national park system. Current BLM multiple-use management policies do not provide legal protection to many of the Great Rift resources. Wilderness designation, if enacted, will provide long-term protection to some, but not all of these resources. Currently, few of the resources are being presented for public enjoyment by the managing entity. A concessioner is being sought to improve visitor facilities and operate Crystal Ice Cave for public use. A guide to features in the proposed wilderness areas is being prepared to expand opportunities for visitor enjoyment. However, development of visitor facilities and interpretive programs will continue to have relatively low priority for much of the area.

Based on these factors, the study team has concluded that the Great Rift system is suitable for inclusion in the national park system.

Other features of the study area, such as Big Southern Butte, Cedar Butte, and the Cerro Grande lava flow, although of local and regional significance, are well represented in the national park system and are not of such national significance that they should be included in the national park system.

FEASIBILITY

The Great Rift area is primarily in public ownership, administered by the BLM. Depending on the boundary selected, relative small acreages of private and state lands might be included. The area boundary could be defined to ensure a size and configuration to provide long-term protection for resources and to accommodate public use. Detailed study would be required to define a boundary that would provide maximum resource protection and sites for visitor facilities with minimal intrusion on existing uses such as ranching, grazing, and hunting, which would be incompatible with NPS management policies. Administration of the area by the National Park Service would require additional personnel and facilities to provide for visitor use, interpretation, and resource management. Elimination of grazing and hunting would require a significant increase in staff and could require extensive boundary fencing.

The lack of an existing improved road system and facilities for visitor use (other than within the existing national monument) limit the immediate possibilities for public use and enjoyment. The need for improved roads and visitor facilities would depend, to a large extent, on the management objectives for the area. The cost to develop access and facilities could be substantial. Rehabilitation of the facilities at Crystal Ice Cave could prove very expensive if the cave was restored to more natural conditions.

Although the Big Southern/Cedar Butte area is not considered suitable, it would be feasible for inclusion in the national park system. Similarly, other features on the plain are clearly of local and regional significance and deserve protection. For the most part, existing BLM management policies are providing adequate protection, but these are subject to evolutionary change.

Possible Alternative Management Strategies

NPS Management. An expanded park could be a contiguous area, including major portions of the Craters of the Moon lava field now outside the monument, the Open Crack Rift Set, the King's Bowl Rift Set and the Bear Trap lava tube area, and the Wapi lava field.

An alternative boundary could have a northern unit, consisting of the Craters of the Moon lava field and portions of the Open Crack Rift Set, and a southern unit, consisting of the King's Bowl Rift Set and the Bear Trap lava tube area, Split Butte, and the Wapi lava field. Both would be feasible management units. The southern area, remote from monument headquarters, would probably be managed as a separate district, with offices in American Falls or another nearby city. Housing for personnel would be obtained on the open market in nearby communities, although seasonal housing at some sites might be required to provide resource protection. Depending on management objectives, the costs of management could be reasonable, although a significant increase in the present monument budget would be needed.

The Big Southern/Cedar Buttes area is primarily in public ownership, administered by BLM from Idaho Falls, approximately 60 miles to the northeast and approximately 45 road miles east of NPS monument headquarters. Primitive roads provide access to the area, including a road to the top of Big Southern Butte, which is open to the public. Communications facilities and a fire lookout occupy the summit of the butte. These are essential management activities and would need to be continued if the area is placed under NPS management. The area boundary could be defined to ensure long-term protection for resources and accommodate public use. It could be a detached unit of the monument (or park) administered from the existing monument headquarters. Administration of the area would require additional personnel and possibly the establishment of living quarters for protection, maintenance, and interpretive personnel. Costs to provide adequate visitor services and facilities could be high, depending on management objectives.

Interpretation at Craters of the Moon National Monument places emphasis on the features within the monument. However, more emphasis is being placed on the Great Rift system as interpretive media are updated. Public understanding of features outside the monument can be enhanced through improved interpretation within the monument. It would not be essential to expand the monument to encourage the public to explore these associated features. However, some unique features in the Kings Bowl/Wapi area deserve improved protection and better on-site interpretation. Many of the other features, such as the Black Top Butte area, Huddle's Hole, Old Juniper Kipuka, Split Butte, and Bear Trap Cave, could be managed as remote areas reached only by primitive roads and trails, thus requiring relatively little development effort other than directional signing, some road maintenance, and possibly some interpretive waysides. Conversely, these areas could receive emphasis as visitor destinations with high development and management costs. Access roads would be a major cost.

Cooperative Management. To some extent, Park Service management of the expanded area would duplicate existing management by BLM on adjacent lands. Alternative management strategies, such as cooperative agreements with BLM for some functions, could reduce management cost. Unless the Park Service were to establish on-site protection and interpretation presence and significantly enhance the visitor experience, it may be in the best public interest to continue the existing BLM management if adequate resource protection is ensured.

Alternatives for cooperative NPS/BLM management could be explored if a study of alternatives is pursued. Such alternatives might include designation of a Craters of the Moon National Conservation Area for much of the BLM area, with the Park Service cooperating in providing interpretive planning, personnel, and facilities with general administration remaining under BLM. The resulting area could be designated a national monument/national conservation area similar to El Malpais. It could also be designated a national park/national conservation area. However, the area lacks the diversity of resources generally associated with a national park.

Summary of Suitability/Feasibility

Expansion of the existing monument to include the major features of the Great Rift system is both suitable and feasible. Although the cost for establishment would be low, the cost for development could be high. The potential expansion area includes significant related features of volcanism not contained in the existing monument. For the most part, these features would be adequately protected if the proposed wilderness legislation is enacted by Congress. However, some significant features would remain subject to evolving management policies and protection would not be ensured. Existing management policies on these lands place relatively low priority on public use and understanding of these resources.

Expansion of the monument or boundary adjustment (other than those currently proposed in the northwestern portion of the monument) would not improve management of the existing unit's resources. Costs to eliminate grazing and hunting from the expansion area, as required by NPS management policies, and patrols to protect the additional resources from vandalism, poaching, and collecting could be very high.

Although the Great Rift system is a suitable and feasible addition to the national park system and deserves a higher degree of legal protection than it now receives, management by the National Park Service might not provide the most efficient administration at reasonable cost. Unless there were considerable expenditures for access and visitor facilities, there would be little net gain for the visitors. Even with such expenditures, visitation to the remote areas would probably be quite low because of the lack of a concentration of "spectacular" features with high interpretive value such as exists in the present monument. The desired degree of protection of the resource as a nationally significant area of scientific interest and improved presentation of selected features for public use could be achieved through less costly management strategies.

If further study is directed, management objectives should be defined, and management alternatives and their environmental consequences should be evaluated to seek a means to reduce the potential cost of managing and developing the area and to ensure long-term resource protection. Cooperative management by NPS and BLM would permit most

traditional uses to continue. Designation of the BLM lands adjacent to the monument as a national conservation area should be given consideration.

APPENDIXES

APPENDIX A: OTHER STUDY AREA RESOURCES

INTRODUCTION

The information in this section was obtained from various sources without additional field research. There is some conflicting information, and the level of detail varies between BLM districts. Generally, the information obtained is adequate to determine the suitability and feasibility for expansion of Craters of the Moon National Monument. Additional fieldwork would be required to establish management objectives and alternatives and to define boundaries.

PERCEPTUAL ENVIRONMENT – SCENIC AND VISUAL QUALITY

Most of the volcanic features in the study area are large and of low relief. Only from the air can the features be placed in perspective. The area is characterized by uniform, gently sloping lava plains that rise from 4,195 feet above sea level at Lake Walcott on the Snake River to 5,800 feet at the Craters of the Moon visitor center at the base of the Pioneer Mountains. Craters of the Moon National Monument, with features over 6,500 feet and views over the lava flows to the south, occupies the highest elevation on the Great Rift system. At 7,500 feet, Big Southern Butte dominates the study area because of its elevation. A shrub-steppe desert grassland begins where the lava flows end, with almost no relief over miles of sagebrush and bunchgrasses. Some topographic relief is provided by various cinder cones and other volcanic features.

The area has been described as stark and harsh, but it has its own rugged beauty. The lavas vary in color, the more distinctive ones having been named (i.e., Blue Dragon and Green Dragon). Shapes and textures of the flows add scenic variety on a small scale. The most recent lava flows are barren of vegetation. There are kipukas – areas of vegetation on old lava that are surrounded by new lava – that offer some visual relief from the continuous lava. Seasonal wildflower displays brighten the lava flows and contrast nicely with the dark lavas.

ACCESS

Craters of the Moon National Monument offers the only improved road access to examples of many of the volcanic features. The study area is bounded by paved roads, but the roads within are dirt or gravel. Some of the roads are ill-defined. The sharp lava is not conducive to vehicle travel, and very few roads cross the lava. Many roads and ORV trails lead no further than the lava's edge and are a confusing maze. The only reliable landmark is Big Southern Butte. There is no vehicle access to most of the lava features from approximately December 1 through mid-March because of snow.

The main dirt road on the east side of the Great Rift runs from Minidoka to Arco over a distance of 47 miles. The road runs between the Craters of the Moon and the Wapi flows and crosses the southern edge of the Open Crack Rift Set, and provides access to Bear Trap lava tube.

The road to Crystal Ice Cave from I-84 at American Falls travels through agricultural lands before reaching sagebrush desert. The dirt portion of the road must be maintained each

spring. It is possible to drive from Bear Trap Cave to Crystal Ice Cave, although the maze of unimproved roads is confusing.

There are trails leading into the lava, but few are well-defined. The rugged and irregular lava surfaces make walking difficult. Rough aa lava wears down hikers' boots, is hard on ankles, and is basically impassable to tender-footed animals like domestic dogs.

PHYSICAL ENVIRONMENT

Climate

The climate is a modified continental type, influenced by Pacific air masses with cold, snowy winters and hot, dry summers. There are wide ranges in seasonal and daily temperatures (104° to -37° F), wind velocities and directions, and precipitation. The 8 to 16 inches of total annual precipitation falls mainly as snow. Most precipitation occurs in November, December, January, May, and June.

Soils

Soils in the study area are generally well-drained and medium-textured silt loams, loams, and some variable depth sandy loams overlying basalt. At the base of the buttes, soils are developed from alluvium.

Air Quality

Air quality in the area is generally good except for short periods when agricultural lands are burned or cultivated. The Great Rift Wilderness Study Area is in an area classified by the Environmental Protection Agency as class II, which means that the deterioration in air quality that normally accompanies moderately well-controlled growth would be considered insignificant. The Craters of the Moon Wilderness is a class I air quality area, which means that almost any decrease in air quality would be considered significant. Visibility monitoring at the monument indicates that the air quality is pristine, with total suspended particulates measuring among the lowest in the continental United States.

In 1984, the INEL received a prevention of significant deterioration (PSD) permit for construction and operation of a coal-fired steam generation facility. In 1988, the INEL received another PSD permit for a fuel processing restoration facility. Projections are for more applications for PSD permits in the near future. The INEL and Park Service are cooperating to monitor air quality to determine if these facilities will contribute to the deterioration of air quality.

Water Resources

There are only two natural springs in the study area east of the Great Rift, both on Big Southern Butte. One is private (Frenchmans Spring) and the other (Webb Spring) is maintained by BLM. Wells and catchment basins for runoff water are the only other water sources on the east side of the study area, with the exception of the Big Lost River. BLM drilled about 30 wells, which are maintained by stockmen. Wildlife as well as livestock benefit from these water sources. In the Wapi area, stockmen have built storage tanks and troughs, and water is hauled in.

On the northeast side of the Great Rift, near Arco, is the Big Lost River. The river flows out into the desert where it forms a lake and then disappears into the ground, hence its name. The river may become an underground stream and emerge (along with other streams that vanish underground in the area) as the Thousand Springs, northwest of Twin Falls. West of the Great Rift is the Little Wood River, a tributary of the Snake River. Although there are no streams in most of the study area, the winter snowmelt collects in small depressions to provide a seasonal water source for wildlife, as well as a moisture source for ice in some of the deep depressions and lava tubes.

Ironically, the desert is underlain by the Snake River aquifer, the largest in the world. Based on well depths, the aquifer is about 800-1,000 feet under the land surface on the east side of the Great Rift, 700 feet deep at Craters of the Moon National Monument, and 800 feet deep at Crystal Ice Cave. On the west side of the Great Rift, well depths average 300 feet.

The watershed is in moderate to stable erosion condition. BLM has reseeded some areas to provide protection from erosion where the existing vegetation has been removed or damaged.

BIOTIC ENVIRONMENT

Vegetation

Although some of the younger lava flows are barren of vegetation, there is a surprising diversity of plant communities in the study area. There are about 90 species of plants in the existing monument, but there are over 300 species in the study area. The type and density of vegetation varies widely depending on the availability of soil. The lavas and kipukas show a full range of ecological succession – from pioneer plants such as lichens and mosses on the basalt surfaces to entire plant communities in the kipukas. There are also limber pine forests on the cinder cones of the northern Craters flows. Juniper trees occur in the older lava flows, on the southern Craters flows, and on much of the Wapi flow. The transition between limber pine and juniper vegetation types occurs between Black Top Butte and the existing monument. This ecotone normally occurs only in montane regions and is thus an unusual feature for the lava flows.

Where very young basalt rock occurs, the only soil available is what blows into the cracks and fractures. The amount of soil determines what vegetation is present. Penstemon and gland cinquefoil grow in shallow soils, while tansybush, rock spirea, and syringa are present in deeper crevasses.

Cinder cones support three different plant communities, depending on successional stage and aspect. In the early successional stages, cinder gardens are colonized by dwarf buckwheat, silverleaf phacelia, Douglas chaenactis, dwarf monkeyflower, and bitterroot. The cinder gardens produce spectacular spring wildflower displays. As soils develop on the cinders, shrub communities dominated by antelope bitterbrush form. On north-facing slopes of the northern Craters flows (and in some crevasses) where sufficient moisture is available, limber pine and less commonly, Douglas-fir, are present.

The dominant shrub species are basin big sagebrush, threetip sagebrush, Wyoming big sagebrush, and gray and green rabbitbrush. Common grasses are bluebunch and western wheatgrass, Sandberg bluegrass, needle-and-thread grass, needlegrass, bottlebrush squirreltail, basin wildrye, Idaho fescue, and cheatgrass. Crested wheatgrass has been used extensively in the study area for reseeding projects following fires.

Riparian habitat is very scarce in the study area because of the climate, topography, and soils.

A shrub-steppe vegetation of sagebrush and bunchgrasses occurs where soils have developed in the kipukas and the areas surrounding the new lavas.

The native species composition has been altered by domestic livestock grazing and fire in most places except for some kipukas. Some of the kipukas, protected by new rough lavas, offer examples of ungrazed native sagebrush grasslands of Idaho. They are valuable as a standard of range conditions prior to grazing and offer a unique opportunity to observe climax vegetation for the study area. No more than 10 of the 450 kipukas in the Great Rift have been grazed by domestic livestock.

Old Juniper kipuka lies in the Wapi field at least 3 miles from the lava edge in all directions. One of the fascinating features of this kipuka is the presence of several large juniper trees over 700 years old.

Huddle's Hole kipuka, mostly on private land, is an old volcanic vent surrounded by the Craters flow. The contrast between old and young lavas is remarkable.

Bear Park is the largest kipuka within the study area. It covers approximately 2.5 square miles in the southern Craters flow. Sheep have been trailed across the 1.5 miles of lava to reach the kipuka, so it is not a pristine area.

Laidlaw Park and Little Park are generally not thought of as kipukas because of their great size, although they are areas of vegetation surrounded by new lava. There is road access to these parks.

Noxious weedy species present near or in the study area are cheatgrass, leafy spurge, spotted knapweed, halogeton (on the sheep driveways), common mullein, and Canadian thistle. Noxious weed control efforts have included fire to control cheatgrass and herbicide to control leafy spurge and spotted knapweed. Except for cheatgrass, noxious weeds are not a major problem.

Wildlife

Within the monument, one amphibian, seven reptile, 142 bird, and 49 mammal species have been reported, and because the study area would include lands that most closely resemble those in the existing monument, species composition is expected to be similar.

The most common animals are horned lizards, mourning doves, sage grouse, killdeer, magpies, ravens, crows, Clark's nutcrackers, common nighthawks, mountain bluebirds, great horned owls, golden eagles, bats, rabbits, chipmunks, ground squirrels, pack rats, pocket gophers, badgers, coyotes, mule deer, and pronghorn antelope. Rabbits, coyotes, mule deer, and antelope are the most commonly seen. Rattlesnakes often inhabit the basalt ledges around lava tubes.

Mule deer, antelope, and sage grouse are the main game species in the study area. The mule deer population is scattered, with local concentrations depending on the season. Water and cover, but not forage, are limiting factors for mule deer. Estimated numbers of animals in the area to the east of the Great Rift are between 143 and 175 in spring, summer, and fall, and are about 325 in winter. On the west side of the Great Rift, numbers are about the same for spring, summer and fall, but an estimated 1,600 deer winter to the west of the Craters of the Moon lava field during typical winters.

Pronghorn antelope are widely scattered over the study area. To the east of the Great Rift, populations are between 465 and 840 animals in spring, summer, and fall and about 416 in winter. The major wintering grounds for the antelope are on the INEL site, near the town of Blackfoot, and in the agricultural lands on the southeast border of the study area. Three crucial fawning areas are concentrated around Quaking Aspen Butte, Tea Kettle Butte, and Split Top Butte.

Sage grouse depend on sagebrush for food. Sagebrush also provides cover for protection from predators. Strutting grounds and nesting and brood-rearing areas are crucial for sage grouse. Known strutting areas border the Craters of the Moon lava flows. The population of sage grouse within the lavas of the Great Rift WSA is unknown, but sage grouse droppings are very common in the kipukas and on the lava surface.

A small herd of 75-100 elk has colonized about 200 square miles of the sagebrush lands near Big Southern Butte. Reproduction is occurring in the herd, but it is not yet known how fast the population is increasing or if it will level off. The numbers of elk are not currently high enough to have a negative impact on wildlife, livestock, or agricultural crops.

The Fish and Wildlife Service (USFWS) does predator control, primarily by aerial gunning for coyotes, at the request of stockmen.

THREATENED, ENDANGERED, AND SENSITIVE SPECIES

Animals

There are no threatened or endangered animal species on the federal or state lists that permanently inhabit or breed in the study area. Bald eagles and peregrine falcons fly through the area and may occasionally forage there. These birds winter around the American Falls Reservoir on the Snake River.

Some species have a restricted range, specific habitat requirements, and/or low numbers, which make them vulnerable to elimination if adverse impacts on populations or habitat occur. These species of special concern that occur or probably occur in the study area are the long-billed curlew, Swainson's hawk, ferruginous hawk, merlin, gyrfalcon, burrowing owl, Preble's shrew, kit fox, and lynx. Six species of mammals, and most birds, are state protected nongame species. The protected mammals are pikas, least and yellow pine chipmunks, golden mantle ground squirrels, red squirrels, and kit foxes.

The USFWS is currently seeking information on biological vulnerability and threats to support a proposal to list the long-billed curlew, Swainson's hawk, ferruginous hawk, and the Preble's shrew as threatened or endangered (category 2) species.

An insect of special interest, which occurs only in Idaho lava tubes, is the Idaho lava tube beetle (*Glacicavicola bathyscioides*). This species, known from Craters of the Moon National Monument and Crystal Ice Cave, is under review by USFWS for recognition as a candidate species for endangered listing.

Plants

There are several endangered, sensitive, or candidate plant species that occur or probably occur in the study area. To find rare plant taxa, extremely detailed surveys of likely habitat are necessary. Because of the inaccessibility of the area, such surveys have not been done. Weather and moisture regime often determine the appearance of a plant. In a desert environment like the Great Rift area, an annual plant may not appear for several years if precipitation is inadequate. Besides the following list, additional sensitive, threatened, and endangered plant species might be found within the study area if appropriate surveys were made.

Two state-listed endangered plant species occur or probably occur within the study area. Both species are also category 2 federal candidate species. *Antennaria arcuata* occurs in wet meadows along highway 26/93 between Carey and Craters of the Moon headquarters. *Phacelia inconspicua*, a desert annual, occurred at the base of Big Southern Butte, but has not been seen since 1969. This is an example of an annual plant whose appearance depends on enough moisture.

Astragalus atratus var. *inseptus* probably occurs in the study area in the vicinity of Shoshone and Carey. This species is a category 2 federal candidate species, and is listed as sensitive by the state of Idaho.

Lesquerella kingii var. *cobrensis* occurs on the Cerro Grande lava flow. It is considered sensitive by the state of Idaho.

The Picabo milkvetch (*Astragalus oniciformis*) is on the state list of species to be monitored for changes that could indicate that the populations or habitat are in jeopardy. The species is also a candidate species for federal endangered status. The milkvetch occurs on sandy soils in association with basin big sagebrush and could occur in the study area near Carey.

CULTURAL RESOURCES

Archeology

There is evidence of human occupation of the study area dating back at least 10,000 years. The available resources could not support more than a few small bands of hunters and gatherers; archeological evidence supports this. The earliest recorded inhabitants were big game hunters, who were replaced by a people who utilized a wider variety of plant and animal resources.

The archeological sites that are most significant for understanding the prehistoric inhabitants of the Snake River Plain are the Wadsen and Wilson Butte year-round living sites outside the study area. Occupation within the study area was primarily seasonal (spring and summer). On the west side of the Great Rift, the greatest density of cultural remains is found roughly a mile on either side of the Little Wood River. Site density is low in the upland areas compared to those areas associated with water courses. There are scattered sites throughout the upland sagebrush grasslands and the lava areas on both sides of the Great Rift. Although there are many caves, lava tubes, overhangs, playas, and open blisters, few of them now contain archeological materials. Arrowheads, and the small chips of waste rock produced during their manufacture, as well as hammerstones, choppers, scrapers, and pieces of pottery are widely dispersed in the study area. Trails across the lava indicate that the early inhabitants penetrated the lava flows and entered the kipukas, where a number of sites have been found. The early inhabitants also quarried basalt and obsidian or volcanic glass from the eroded crater walls and veins at Big Southern and Cedar buttes for tool manufacture.

Less than 10 percent of the study area has been surveyed for cultural remains. Most known sites in lava caves have already been collected or excavated by amateur or professional archeologists. Although it is difficult to determine the overall significance based on the small sample, there are several sites of greater-than-average significance – Bear Park, Bear Park Cave, Fissure Cave, and Shadow Butte. On the Wapi flow and in Wapi Park there are 26 sites. These have been protected by the isolation and have a high potential for producing archeological data. At Big Southern Butte, there is a stratified campsite/workshop site at Webb Spring and obsidian quarries on the butte. The small portion of Cedar Butte that was inventoried for cultural remains turned up a dozen quarry, workshop and hunting sites. When the remainder of the butte is surveyed, additional archeological sites will undoubtedly be discovered.

Several sites on the east side of the Great Rift show research potential. Sites eligible for nomination to the National Register of Historic Places are Bear Park Cave, Fissure Cave, and Big Southern Butte. Other groups of sites are eligible as districts, but the information as to their location was not provided.

History

Before about 1800, southern Idaho was the dornain of the Northern Shoshone and Bannock Indians. The Shoshone came from Montana and the Dakotas, driven west by the Blackfoot Nation. The Bannock, from southern Oregon, were a relatively small tribe but they teamed up with the Shoshone when larger groups were required, such as for buffalo hunts. Aboriginal lifestyles remained relatively intact until the Euro-American domination of the area following the discovery of gold and the establishment of permanent agricultural settlements. The Bannock were more warlike than the Shoshone; they were willing to fight for their homeland when the settlers moved in. The native Americans were forced to give up most of their traditional lifeways when the Ft. Hall Indian Reservation was established by treaty in 1868. Through intermarriage on the reservation, the Bannock and Shoshone cultures intermingled.

In the early 1800s, fur trappers were the only Euro-Americans inhabiting the Snake River area. The Fort Hall trading post, overlooking the Snake River southeast of the study area, was the only outpost for hundreds of miles when it was built in 1834. As the fur trading industry declined, Fort Hall became a welcome post for 200,000 emigrants bound for Oregon and California in the 1840s and 1850s. Big Southern, East, and Middle buttes to the east were important landmarks for emigrants on the Oregon Trail. In 1862, Indian raids diverted Oregon Trail emigrants to the northwest. This route, known as Goodale's Cutoff, runs from Big Southern Butte through the existing monument to avoid the lava fields. The cutoff was used as a stage route until 1906.

Gold and silver were discovered in Idaho in 1860, with a subsequent gold rush. Although most mining took place in northern Idaho, there was extensive placer and hydraulic gold mining along the Snake River. The volcanic regions appeared barren and useless until it was discovered that they were good for grazing cattle and sheep. The cattle and sheep industries supplied meat and wool for the mining communities and travelers along the Oregon Trail. The first irrigation ditches were dug in the 1880s. With water, the land was fertile and productive and farms and ranches sprang up. Most private land holdings in the study area were obtained through the Carey Act, the Reclamation Homestead Act, the Desert Land Act, and the Stock Raising Homestead Act, resulting in settlement of most of the remaining arable land by 1930. Huge federally funded projects increased the scale of irrigation projects under these acts.

Other historical uses of the area have included brewing illegal moonshine whiskey in the lava caves, strafing and bombing lava flows, shelling Big Southern Butte with 16-inch naval guns, and testing nuclear reactors.

Big Southern Butte Stage Station and Goodale's Cutoff are eligible for nomination to the National Register of Historic Places. Other sites are eligible for nomination as historic districts; further information about these sites was unavailable.

RECREATION

The primary recreational uses in the study area include Craters of the Moon National Monument, hunting and fishing, ORV use, hiking/camping, and spelunking. Other activities are hang-gliding, cross-country skiing, snowshoeing, photography, bird-watching, sight-seeing, and the study of natural volcanic features. There are no developed recreational facilities in the study area except those at Craters of the Moon National Monument and the concession at Crystal Ice Cave.

There is a BLM-administered special recreation management area (SRMA) along the Little Wood River. A SRMA is an administratively recognized area that possess outstanding recreational resources or where recreation use causes significant use conflicts, visitor safety problems, or resource damage.

Craters of the Moon National Monument comprises the most diverse and geologically recent part of the lava field that covers the southern Snake River Plain. Often described as stark, desolate, uninviting, and a wasteland, the monument is a study in contrasts. The dark lava flows and smooth cinder cones dominate the landscape, relieved only by patches of grasslands and stands of limber pine. The monument, comprising 53,545.05 acres of which 43,243 acres are designated wilderness, contains examples of most of the major basaltic volcanic features found in the Snake River Plain and is noted for the variety of cinder crags, jagged and smooth lava flows, cones and domes, and lava tubes. The searing summer heat of the lava fields can be escaped in the lava caves, some containing permanent ice. Wildlife is relatively abundant (particularly visible during the twilight hours), and wildflower displays can be spectacular.

Visitation averages about 200,000 people per year at the monument, with peak visitation from 10:00 a.m. to 4:00 p.m. every day in summer. Many of the visitors are on vacations that may include Yellowstone and Grand Teton national parks to the east and Sun Valley and the Sawtooth National Recreation Area to the west. Visitation builds to mid-July, remains at peak until mid-August, then drops sharply. Most visitors spend less than 3 hours; five percent remain overnight. The campground (52 sites) fills at night during the summer and is often empty by 10:00 a.m. Backcountry use is minimal due to the harsh surface conditions for walking on the dark lava flows and the lack of water. Winter use, primarily for cross-country skiing and snowshoe use, is minimal, but has been increasing.

Hunting and Fishing

The major big game species hunted are mule deer and antelope. Sage grouse is the most important small game species. Other upland game birds hunted are mourning dove, gray (Hungarian) partridge, and ring-necked pheasant. Craters of the Moon National Monument and the INEL site are closed to hunting.

Antelope hunting is by tag or controlled permit only for rifle and archery seasons. Three antelope hunts are available in the study area (hunting units 52A and 68). The number of permits and length of season may vary annually and are set by the Idaho Fish and Game Commission.

There were both antlered and antlerless archery and rifle seasons for mule deer in the hunting units within the study area in 1988.

Under the current management plan, the Department of Fish and Game will maintain the population but allow no hunting of the desert elk. These elk are very vulnerable to illegal harvest because of low population levels and general lack of cover to hide. Lack of access to the area offers some protection. If elk depredation on private lands becomes a problem, the Department of Fish and Game will take steps to manage the elk accordingly.

There is excellent fishing for large brown and rainbow trout in a section of the Little Wood River along US 93 from the confluence with Silver Creek downstream to Marley Station. Several miles of this reach is managed as a trophy fishery (fly fishing only, catch and release) by Idaho Fish and Game. It is estimated that recreation use accounts for 7,300 visitor days (defined as any portion of a day) in the Little Wood River SRMA. Almost all the use is fishing activity, with dispersed hunting activity being the greatest use of the remainder of the area.

ORV Use

ORV use is allowed in the study area on all lands not closed or restricted. Use is generally dispersed throughout the area and causes minimal impact, with the exception of several buttes. The following areas on the east side of the Great Rift are closed to ORV use: China Cup Butte Research Natural Area, Cedar Butte, Saddle Butte, and Big Southern Butte. ORV use is limited to existing roads and trails on Quaking Aspen Butte and is restricted or closed in other parts of the study area. In the area to the west of the Great Rift, ORV use is concentrated outside of the study area; use within the study area is light.

Hiking and Camping

Existing use of the Craters of the Moon Wilderness offers an area for comparison of potential wilderness use. The backcountry at Craters of the Moon includes lands both within and outside the designated wilderness. Backcountry use is extremely light, with an average of 250 overnight backpackers per year from 1975 to the present. Backpacking parties are usually less than four persons, and they seldom stay out more than two nights because all water must be packed in. Visitor use of the scarce water supply at water holes is discouraged to reserve water for the wildlife. Day use of the backcountry is moderate, estimated at less than 3,000 persons annually.

Spelunking

Lava caves are relatively common in the study area. In the entire area administered by Shoshone BLM District Office, of which the western portion of the study area is a small part, 29 caves have been identified. Most are less than 300 feet long. The caves are known locally and receive much local use. Bear Trap lava tube is the longest in the area and is accessible by road from Minidoka. It may receive more than 100 visitors annually. The less well known caves may be used for recreation only once every two or three years. The Shoshone BLM has identified lava tube caves as areas of geologic interest (AGI). These features require some management attention but are not of national significance. Ten AGI contain caves that are in good condition with fragile cave formations or other

phenomena. Six AGIs contain caves that are heavily used and may present hazards to the public. The caves in good condition are those that are not well known. The better-known caves have had all speleothems removed, and graffiti is evident in all of them. Garbage is also a problem in those caves that are frequently used.

The best known cave in the region is Crystal Ice Cave. This is not a lava tube cave but a fissure cave. The cave is 150 feet deep, with 1,200 feet of tunnel providing access. The cave was developed and run by a concessioner on a permit from the Idaho Falls BLM District Office. The permit was recently revoked for breach of contract; a new concessioner is being sought. When the cave was open, annual visitation was 5,000 to 10,000 people. Improvements at the site include buildings, restrooms, and trails. Generators provide electricity used to light the cave and run a refrigeration unit used to maintain the ice formations.

APPENDIX B: VOLCANIC FEATURES

Lava flows are classified as aa, pahoehoe, or block flows. Aa flows are jagged and have many sharp points. Pahoehoe lava is more fluid before hardening and spreads like thin sheets with smooth, glistening surfaces that are often twisted into rope-like wrinkles. Block flows occur when continuing pahoehoe flows break the twisted surface into rough jagged blocks that are similar to aa lava.

Spatter cones are generally less than 100 feet tall and are formed by blobs of lava thrown up by a vent. Hornitoes and driblet spires are small, steep-sided versions of spatter cones, formed by blobs of viscous lava squeezed from a vent. Tree molds are hollow casts of trees that were surrounded by a lava flow or lava spatter. The best tree molds are found within the boundaries of the existing monument.

A lava tube is a flow channel where the liquid lava moved through while the upper surface hardened. Lava tubes, which vary in size from a few to 50 feet inside diameter and average several thousand feet in length, are scattered over the study area. A tube may have several totally collapsed sections where the tube is obliterated, or have skylights where only the ceiling has collapsed. The longest lava tube system in the area, including its collapsed and open sections, is the 12-mile Bear Trap lava tube. Bear Trap Cave is an uncollapsed section of the Bear Trap lava tube.

Lava bombs are fragmentary volcanic materials that were thrown into the air by a volcanic vent. Most collapse depressions result when gas-inflated pahoehoe flows collapse after partial solidification of flow crusts that allow escape of gases.

Squeeze-ups and pressure ridges form when viscous lava is pushed up through existing cracks or into an elongated ridge. Cinder cones are relatively steep-sided cones built of small fragments of volcanic material that spewed from a vent and fell back into a pile. Because the loosely packed fragments are rather permeable, water runs through the cinders rather than eroding them away.

APPENDIX C: NATURAL HISTORY THEMES – COLUMBIA PLATEAU NATURAL REGION

The relationship of natural history themes to the study area was discussed in the "Significance" section. Features of the study area related to "Works of Volcanism," the theme of prime significance, were discussed in detail. Other themes and their relationship to the study are discussed below.

The study area represents the "Desert Land Ecosystem," a theme of some but not prime significance in the Columbia Plateau. If monument expansion included sagebrush grasslands, representation of this desert theme would increase within the Columbia Plateau. There are more than 450 ungrazed kipukas in the Great Rift lava flows. Ungrazed kipukas are significant with respect to this desert theme because they are remnants of the shrub-steppe vegetation that was widespread before changes in vegetative composition because of the introduction of domestic livestock and frequent wildfires. The ecotone between limber pine and juniper vegetation types that occurs between Black Top Butte and the existing monument is regionally significant because it normally occurs only in montane regions and not on relatively low elevation lava flows.

Representation of the other themes represented by the Great Rift system – "Geologic History" and "Plains, Plateaus, and Mesas" – would not increase significantly with addition of the study area to the existing monument.

The Great Rift system is almost entirely on federal lands, providing opportunities for public use and enjoyment. Regionally, the most significant feature of the Great Rift area is its wilderness character. The remoteness, poor access, and harshness of terrain offer outstanding opportunities for solitude. This is also true of the Wapi flow, although it is not nearly as large, remote, or inaccessible. The Great Rift area has seen relatively little use and, with the exception of Crystal Ice Cave, has integrity as a fairly unspoiled example of the natural forces shaping our planet.

Most of the animal species of concern (the newly arrived desert elk herd, the sage grouse, ferruginous hawks, burrowing owls, long-billed curlews, and Preble's shrew) primarily occupy the sagebrush grassland adjacent to the lava flows. Depending on boundary decisions, the potential expansion area may not contain any large tracts of significant habitat for these species.

Because there are no detailed comprehensive archeological surveys of the study area to date, cultural significance can only be addressed on a superficial level. At least four cultural sites are individually eligible for listing on the National Register of Historic Places – Bear Park Cave, Fissure Cave, Big Southern Butte, and Goodale's Cutoff. There are some groups of sites that would probably be eligible as districts.

NATIONAL PARK SYSTEM PLAN – NATURAL HISTORY THEMES
COLUMBIA PLATEAU NATURAL REGION

Theme	Significance	Representation	Significant Features and Applicability to the Study Area
Plains, plateaus, and mesas	1	A	Broad lava plains are characteristic of much of this region, including the Snake River Plain of southern Idaho, and Craters of the Moon National Monument represents this theme. The representation is listed as adequate; however, some believe more recent studies indicate further representation is warranted.
Mountain systems	1	L	Not applicable.
Works of volcanism	2	S	Snake River basalts, of Pliocene to Recent age, cover large area of south-central Idaho. **Some** of the most outstanding volcanic features of the Snake River Plain are included in the monument. The study area includes the world's best example of basaltic volcanism in a readily accessible setting.
Sculpture of the land	2	L	Not applicable.
River systems and lakes	1	L	Lava flows blocking stream courses have disrupted interior drainage patterns, resulting in one of the largest systems of springs in the U.S. The aquifer feeding these significant springs is largely beneath the study area. Protection of the aquifer is a major concern.
Works of glaciers	1	L	Not applicable.
Caves and springs	1	L	The Thousand Springs area, outside the study area, represents the return to the surface of waters that have entered the lava plain at various places, including the study area. Actions in the study area could impact these significant springs.
Geologic history	1	L	A large percentage of the rocks of this natural region are basalts extruded as lava flows from Eocene to Pleistocene. Of the two major outpourings representing this theme, one – Snake River basalt – is a major feature of the study area.
Tundra	1	L	Not applicable.
Boreal forest	1	L	Not applicable.
Dry coniferous forest and woodland	1	L	Pine forests covering huge areas of shallow volcanic soils — the national monument is marginally representative of this theme.
Grassland	1	L	Native grasslands once covered large areas, but have been drastically reduced by cultivation and overgrazing. Some kipukas in the study area may represent this theme.
Desert	1	L	Although not listed in the plan as a theme for Idaho, some consider the sage desert found in the study area to be a disappearing ecosystem worthy of preservation.
Lakes and ponds	1	L	Not applicable. Reservoirs on the Snake River adjacent to the study area are marginally related.
Rivers and streams	1	L	Limited stream habitat on the edge of the study area may contain native associations of fishes.

Significance of Regional Theme

1 Significant, but not prime
2 Prime significance

Representation in the National Park System

A Adequate representation
S Some representation
L Little or no representation

BIBLIOGRAPHY

BLAKESLY, JENNIFER A., AND R. GERALD WRIGHT

1988 *A Review of Scientific Research at Craters of the Moon National Monument.* Idaho Forest, Wildlife, and Range Experiment Station Bulletin no. 50. Moscow: University of Idaho.

BLUESTEIN, SHELDON

1988 *Exploring Idaho's High Desert.* Challenge Expedition Company, Boise, Idaho.

BUREAU OF LAND MANAGEMENT, U.S. DEPARTMENT OF THE INTERIOR

1980 *Final Environmental Impact Statement, Great Rift Wilderness.* Available at BLM Idaho Falls District Office.

1981 *Draft Environmental Impact Statement, Proposed Range Management Program for the Big Desert Area.* Available at BLM Idaho Falls District Office.

1983 "Monument Planning Area, Analysis of the Management Situation." Available at BLM Shoshone District Office.

1984 *Monument Resource Management Plan and Environmental Impact Statement (Draft).* Available at BLM Shoshone District Office.

1984 *Proposed Monument Resource Management Plan and Final Environmental Impact Statement.* Government Printing Office: Washington, D.C. Available at BLM Shoshone District Office.

1987 *Final Environmental Impact Statement, Monument Wilderness Study.* Government Printing Office: Washington, D.C. Available at BLM Shoshone District Office.

1987 *Interim Management Policy and Guidelines for Lands under Wilderness Review.* BLM Manual, Update Document H-8550-1. Government Printing Office, Washington, D.C.

CHAMPION, DUANE E., AND RONALD GREELEY

1977 "Geology of the Wapi Lava Field, Snake River Plain, Idaho." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, pp. 133-152. Edited by Greeley and King. National Aeronautic and Space Administration, Washington, D.C.

CHRONIC, HALKA

1986 *Pages of Stone: Geology of Western National Parks and Monuments.* Vol. 2: *Sierra Nevada, Cascades and Pacific Coast.* The Mountaineers, Seattle, Washington.

CHRONIC, HALKA
1988 *Pages of Stone: Geology of Western National Parks and Monuments.* Vol. 4: *Grand Canyon and the Plateau Country.* The Mountaineers, Seattle, Washington.

DAY, THOMAS A., AND R. GERALD WRIGHT
1985 *The Vegetation Types of Craters of the Moon National Monument.* Idaho Forest, Wildlife, and Range Experiment Station Bulletin no. 38. Moscow: University of Idaho.

FRANZEN, JOHN G.
1981 "Southeastern Idaho Cultural Resources Overview, Burley and Idaho Falls Districts." Final Report R-2196. Commonwealth Associates Inc., Jackson, Michigan.

GEHR, ELLIOT A., EVELYN LEE, GRETCHEN JOHNSON, J. DONALD MERRITT, AND STEVEN NELSON
1982 "Southwestern Idaho Class I Cultural Resources Overview for the Bureau of Land Management Boise and Shoshone District, Idaho." Contract no. YA-553-CT1-1095. Vol. I, Professional Analysts, Eugene, Oregon.

GEOLOGICAL SURVEY, U.S. DEPARTMENT OF THE INTERIOR
1985 "The Geology of Lava Beds National Monument," by Julie M. Donnelly-Nolan. Wang document 4476d. Manuscript.

GREELEY, CYNTHIA
1977 "Idaho: Indian Country to Statehood." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, pp. 253-260. Edited by Greeley and King. National Aeronautic and Space Administration, Washington, D.C.

GREELEY, RONALD
1977 "Aerial Guide to the Geology of the Central and Eastern Snake River Plain." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, pp. 59-112. Edited by Greeley and King. National Aeronautic and Space Administration, Washington, D.C.

1977 "Basaltic Plains Volcanism." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, pp. 23-44. Edited by Greeley and King. National Aeronautic and Space Administration, Washington, D.C.

1977 "Volcanic Morphology." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, pp. 5-22. Edited by Greeley and King. National Aeronautic and Space Administration, Washington, D.C.

GREELEY, RONALD, AND JOHN S. KING, EDS.
1977 *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook.* Office of Planetary Geology, National Aeronautics and Space Administration, Washington, D.C.

GREELEY, RONALD, EILENE THEILIG, AND JOHN S. KING
1977 "Guide to the Geology of King's Bowl Lava Field." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, pp. 171-188. Edited by Greeley and King. National Aeronautic and Space Administration, Washington, D.C.

KING, JOHN S.
1977 "Crystal Ice Cave and King's Bowl Crater, Snake River Plain, Idaho." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, pp. 153-164. Edited by Greeley and King. National Aeronautic and Space Administration, Washington, D.C.

1977 "Regional Setting of the Snake River Plain, Idaho." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, pp. 45-58. Edited by Greeley and King. National Aeronautic and Space Administration, Washington, D.C.

KUNTZ, MEL A., DUANE E. CHAMPION, RICHARD H. LEFEBVRE, AND HARRY A. COVINGTON
1988 "Geologic Map of the Craters of the Moon, Kings Bowl, and Wapi Lava Fields, and the Great Rift Volcanic Rift Zone, South-central Idaho." U.S. Geological Survey Miscellaneous Investigations Series Map I-1632.

KUNTZ, MEL A., DUANE E. CHAMPION, ELLIOT C. SPIKER, AND RICHARD H. LEFEBVRE
1986 *Contrasting Magma Types and Steady-state, Volume-predictable, Basaltic Volcanism along the Great Rift, Idaho.* Geological Society of America Bulletin 97:579-594.

KUNTZ, MEL A., RICHARD H. LEFEBVRE, DUANE E. CHAMPION, JOHN S. KING, AND HARRY R. COVINGTON
1983 "Holocene Basaltic Volcanism along the Great Rift, Central and Eastern Snake River Plain, Idaho." Utah Geological and Mineral Survey Special Studies 61:1-33.

KUNTZ, MEL A., ELLIOT C. SPIKER, MEYER RUBIN, DUANE E. CHAMPION, AND RICHARD H. LEFEBVRE
1986 "Radiocarbon Studies of Latest Pleistocene and Holocene Lava Flows of the Snake River Plain, Idaho: Data, Lessons, Interpretations." *Quaternary Research* 25:163-176.

MAXWELL, CHARLES H.
1982 *El Malpais.* New Mexico Geological Society Guidebook, 33rd Field Conference, Albuquerque Country II,. pp. 299-301.

MAXWELL, CHARLES H.
1986 "Geologic Map of El Malpais Lava Fields and Surrounding Areas, Cibola County, New Mexico." U.S. Geological Survey Miscellaneous Investigations Series Map I-1595.

NATIONAL PARK SERVICE, U.S. DEPARTMENT OF THE INTERIOR
1970 "The Works of Volcanism: Sites Recommended as Potential Natural Landmarks," by Robert H. Rose.

1971 "A Descriptive Survey of Potential Desert Parkland Areas along the Great Rift Zone of Southeastern Idaho," by Karl A. Urban and Fred M. Bullard. Available at Denver Service Center Technical Information Center.

1972 *Part Two of the National Park System Plan: Natural History.* Government Printing Office, Washington, D.C.

1987 *Craters of the Moon National Monument, Resources Management Plan and Environmental Assessment.* Available at Denver Service Center, Technical Information Center.

NATIONAL SPELEOLOGICAL SOCIETY
n.d. "Ape Cave – A Guide for Exploration." Vancouver, WA.

NICHOLS, ROBERT L.
1945 *McCartys Basalt Flow, Valencia County, New Mexico.* Geological Society of America Bulletin, vol. 57:1049-1087.

PAPADAKIS, PEGGY L.
1968 "A Special Report to the Bureau of Land Management, Idaho Falls, Idaho on the Crystal Ice Caves, American Falls, Idaho." typewritten manuscript. Available at BLM Idaho Falls District Office.

PAPSON, RONALD P.
1977 "Road Log from Pocatello to Craters of the Moon National Monument." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, pp. 262-270. Edited by Greeley and King. National Aeronautic and Space Administration, Washington, D.C.

POLDERVAART, ARIE
1971 "Volcanicity and Forms of Extrusive Bodies." In *Volcanic Landforms and Surface Features*, pp. 1-14. Edited by Jack Green and Nicholas M. Short. New York: Springer-Verlag.

PRINZ, MARTIN
1970 *Idaho Rift System, Snake River Plain, Idaho.* Geological Society of America Bulletin, vol. 81:941-1948.

SNEED, PAUL
1966 "A Preliminary Report of the Archeological Reconnaissance of the Craters of the Moon National Monument." Available at Denver Service Center Technical Information Center.

SPEAR, DALLAS B.
1977 "Big Southern, Middle, and East Buttes." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, pp. 113-120. Edited by Greeley and King. National Aeronautic and Space Administration, Washington, D.C.

STEARNS, HAROLD T.
1963 *Geology of Craters of the Moon National Monument, Idaho*. Craters of the Moon Natural History Association, Arco, Idaho.

STUART, AMY M.
1977 "Flora and Fauna of Craters of the Moon National Monument." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, pp. 228-232. Edited by Greeley and King. National Aeronautic and Space Administration, Washington, D.C.

WENTWORTH, CHESTER K., AND GORDON A. MACDONALD
1953 *Structures and Forms of Basaltic Rocks in Hawaii*. U.S. Geological Survey Bulletin 994. U.S. Government Printing Office, Washington, D.C.

WOMER, MICHAEL B.
1977 "The Origin of Split Butte, a Maar Type Crater of the South-Central Snake River Plain, Idaho." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, pp. 189-202. Edited by Greeley and King. National Aeronautic and Space Administration, Washington, D.C.

PREPARERS AND CONSULTANTS

NPS Study Team

Robert Allen – Landscape Architect/Landscape Planner, Denver Service Center (DSC)
Douglas Cornell, Jr. – Architect/Planner – Team Captain, DSC
Roberta McDougall – Interpretive Planner, DSC
Aida Parkinson – Resource Management Specialist, DSC
Robert Scott – Superintendent, Craters of the Moon National Monument

Consultants

Lloyd Ferguson – District Manager, Idaho Falls District,
Bureau of Land Management (BLM)
Mel Kuntz – US Geological Survey, Denver, Colorado
Ivan Miller – Chief, Office of Planning, NPS Pacific Northwest Regional Office
Staff from Craters of the Moon National Monument
Staff from the BLM Idaho Falls, Shoshone, and Burley district offices
R. Gerald Wright – Coopèrative Park Studies Unit, University of Idaho

Numerous individuals from:
Bonneville Power Administration
Idaho Department of Fish and Game
Idaho Department of Transportation

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